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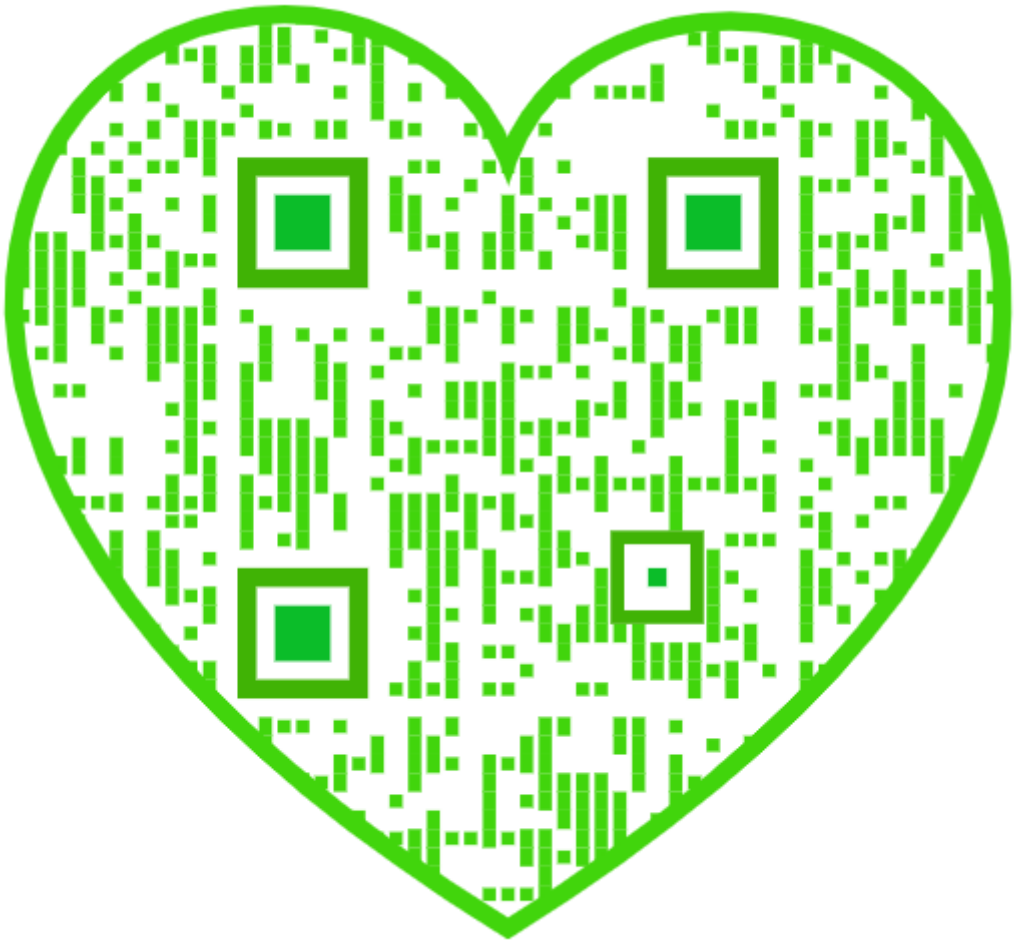

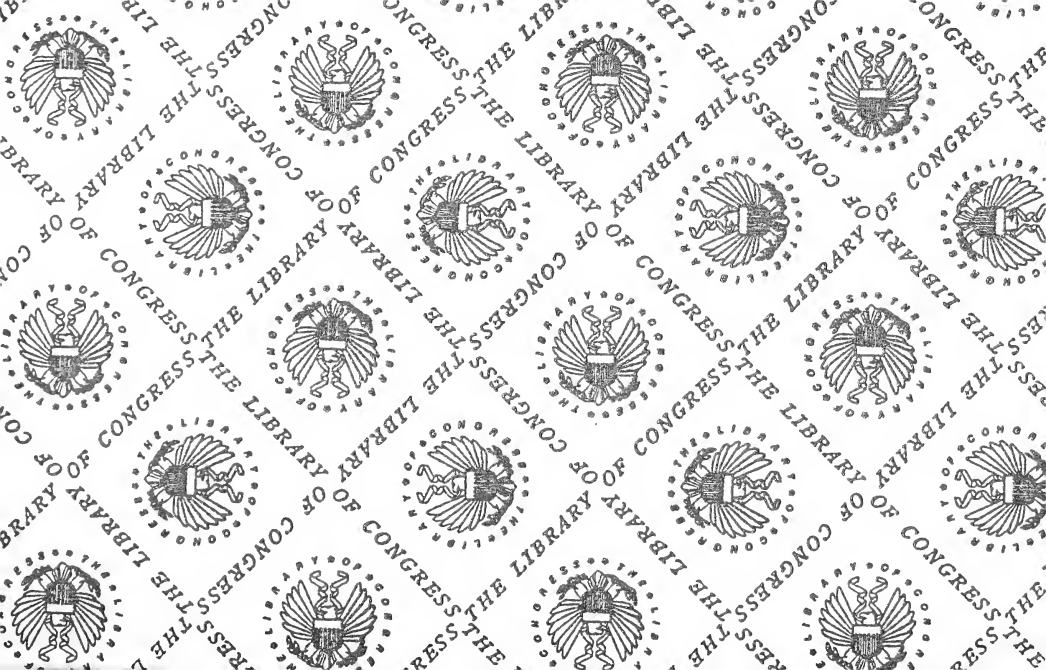
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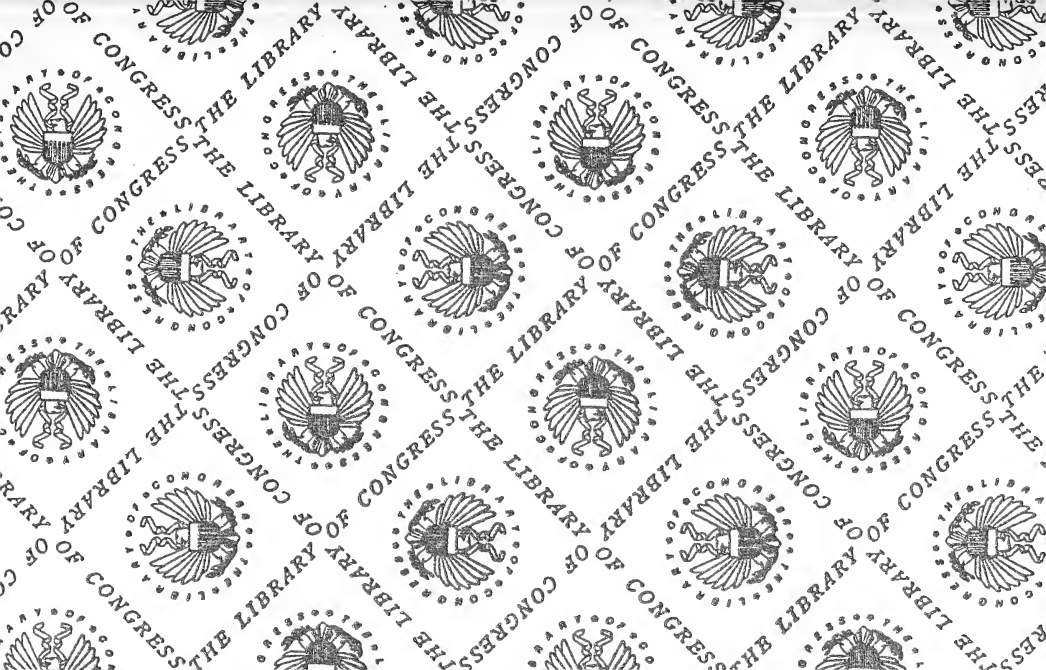
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LUMBER INSPECTION.

One of the most difficult tasks in the domain of lumber literature is the putting upon paper of a description of those various divisions or grades which are found to prevail in different localities. Surveying, as it is known in Maine and some other localities, Inspection, as it is termed in Albany and the West, consists of fixing a value to each individual piece of lumber. Inasmuch as no two are exactly alike, it is impossible to establish an arbitrary rule for the guidance of the Inspector, and as a consequence, the individual judgment must determine the value of each, from a consideration of its general character, and the uses to which it can be put in house building or manufacture.

As the judgment of men varies as much as each piece of lumber from its fellow, it becomes very difficult for one to see the value and character of a board exactly as it is seen by all others, and hence it is well nigh impossible to prescribe what shall constitute a board of any particular grade. If it be perfect in all other respects, it may not be of equal value with another equally, but no more, perfect board, in that it is of a more glassy, brash and tough texture, less straight and free in grain, and wholy unfit for the finer uses to which its fellow may be well suited. All these and many other considerations enter into the proper and judicious assorting and valuing of lumber, and must be determined according to the judgment and experience of the Inspector.

But while no arbitrary rule can be established, it was determined early in the history of the trade, that one could be applied to the general characteristics of lumber, which would guide both the buyer and seller in determining the value of a given piece. While these general characteristics applied to the distributions between the manufacturer and the consumer in the infancy of the trade, while but a comparatively small quantity was produced and consumption kept pace with production, when the demand increased and it was found necessary to build mills in the forest at a distance from the consumer, middlemen became necessary, and at various points in the country immense depots were established, to which the mill product could be shipped, and whence it could be distributed. But the still increasing population moving further and further from the points of

supply, necessitated another set of distributors, and the first began to confine their trade to selling, at wholesale, to the latter as retailers.

Now, the rules that had guided the mill-man in selling to his customers, required modification, and to prevent too great an advance in price, the retailer was compelled to obtain his compensation through a division into grades, and this system of grading has advanced to its present status, which may be almost classed among the fine arts, yet marked by as great a variance as there are individual judgments to determine it.

It is the purpose of this work to endeavor to point out the general laws governing the inspection of lumber, without expecting to wholly harmonize the ever conflicting opinions of the grand army of knights of the board rule. If, however, it succeeds in establishing a more generally uniform system of Inspection and yard-grading, the effort may well be called successful.

Albany, N. Y., after Bangor, Me., and Port Deposit, Pa., early became the most important center of the lumber trade of the country, and promulgated a system of Inspection, or sorting into qualities, which soon superceded the early rule of Surveying, which was simply straight measure, or the determining of the number of feet, regardless of quality. In this connection it may properly be said, that in the early days of lumber manufacture, it was the aim and custom of the producer to cut only the better class of trees, and it is within the memory of the writer, when the grades now known as Selects, Fine Common, or Picks, was the poorest which found its way to market as Common, and that which now comprises the bulk of the lumber handled, was considered as only fit to be sold at the mill, and such of it as by accident found its way to market was sold for what it would bring, often not realizing the cost of transportation. The growth of the trade, however, soon admonished the manufacturer that he must be more conservative with his timber, and the shipments and sale of Coarse Common, which included all between the present grade of Selects and Culls, was undertaken.

The fast depleting forests and the increased consumption throughout the country, especially of the lower grades, soon demonstrated that consumers were utilizing the cheaper product for cutting-up lumber, and that doors, sash and other building material could be made equally well from this grade as from the higher priced qualities. Albany now began to select out the nicer Common below the Fine Common grade, and Pickings became a favorite in that district.

If the wholesaler could make Pickings out of the Common, the retailer, equally fertile in resources, could make other qualities, and so subdivisions, such as A and B Selects, B Box, B Stock, 8-inch Flooring, and a hundred other designations came in vogue. These are one and all but sub-divisions of the old and well-known Albany grades, Clear, Fourths,

Box, Common, and Culls, more particularly of the Common. The designations given are uniform, but as before remarked, the selection varies widely, and an A Select in one yard may be bought as a Third Clear, or A Box, or even as a B Box in another.

The various systems of Inspection, Grading and Measurement are given in the following pages in about the order of their adoption in the different localities. It is more than probable that if any one standard of yard-grading is adopted universally at wholesale centers, it will be something very similar to that in vogue in Chicago, as it is believed to come nearest to meeting the general want of any method now in use. Markets competing directly with Chicago have aimed to grade as near like it as possible, and if this little work affords any aid in this direction, it will be a source of very great satisfaction to the publishers.

ALBANY INSPECTION.

This was originally divided into five qualities, viz.: Clear, Fourths, Box or Selects, Common and Culls. Clear, or Three Uppers, was sub-divided into three grades: First, Second and Third.

First Grade.—A First Clear board shall be perfect in all respects, free from wane, knot, rot, shake or check, not less than twelve feet long and eight inches wide, (in any case) unless a very wide and thick piece, when a minimum length of ten feet may be allowed.

Second Grade.—Not less than twelve feet in length, unless very wide and thick, with not more than two defects, *i. e.*, two sound knots which could be covered by a York shilling (dime), or sap equal to one inch on one side, or one knot and one sap; not less than ten inches wide, well manufactured, and free from rot, shake or check.

Third Grade.—Not less than twelve feet long, unless very wide and thick, and ten inches wide, free from rot, shake or check, when three defects might be allowed; either three knots which a York shilling would cover, or two saps an inch wide, with one small knot. If very wide the defects might be allowed slightly to increase, but not so as to injure the general character of the piece. These three grades are included in one and designated Clear or Good.

Fourths.—Not less than twelve feet long and twelve inches wide, with not exceeding four defects at that width, viz.: if free from sap, four sound knots on the heart side, not larger than a dime; if free from knots, two saps which must not exceed two inches on each edge, and must be

bright. At the minimum width, one face must be perfect; with increasing width latitude may be allowed to the extent of the sap.

Select Box.*—Not less than twelve feet in length and eight inches in width in any case. Must, if narrow, have one perfect face, and may have small knots, not exceeding five, in a width of fourteen inches or more. Sap may meet on one end, for not more than one-fifth the length, or two saps may be allowed on sap side, but must have at least three inches of heart wood between; sap must be bright; must be free from rot, shake and checks.

Box or Common.—All sound lumber free from knots, shaky hearts, rot, shake and worm holes which is below the grades before named, shall be classed as Box or Common.

Pickings.—A grade of common which in its general character will dress one side clear, or has no great number of small knots, but is suitable for finishing lumber. (A good fine common, but indifferent select.)

Culls.—Will not hold water, shaky, rotten, coarse knots, black and mouldy sap. If very rotten, embracing more than one-eighth of the board, it becomes a scoot, refuse or mill cull. Market culls must be good enough to make hog pens, board fences or roof boards.

Scoots, Refuse or Mill Culls.—Lumber that is not worth removing from the mill, and is fit only to be burned.

*In the early days of the trade, the grade Select was known as Box, while Sound Common was known as Merchantable.

MICHIGAN INSPECTION.

The Saginaw Valley became the most extensive producing section of the country from about the year 1850, it being in the hey-day of its prosperity from about 1860 to 1875, during which period its manufacturers approximated yearly shipments from six to eight hundred million feet, and sales were ostensibly governed by Albany Inspection. The grade was of superior quality, and the question of Inspection became an important one. In order to secure as nearly as possible a uniformity in this regard, the manufacturers in 1873 obtained the passage of an Act of the Legislature, establishing in each organized County or other sub division of territory, Inspection Districts, each having an officer known as Inspector General, with Deputies and Sub-Inspectors to be appointed by him. The details of this law, which was subsequently repealed, need not be given here, but the inspection presented by it, being somewhat, in its governing prin-

ciples, in force by reason of prevailing custom, will be of interest to lumbermen everywhere.

It will be observed that in the upper grades, especially First Clear, it is more liberal than Albany, wherefore it may be argued, that inasmuch as a large proportion of the better grades from Eastern Michigan find their way to Albany, and are subject to inspection there, the present custom at Albany conforms very nearly to the rules established in Michigan.

Allowance must be made for the fact that established usage in Saginaw does not fully conform to the law as written. In fact, under the operation of the law, it is presumable, upon good grounds, that it was never strictly adhered to. It is a noticeable fact in all markets, that Inspection varies largely with an advancing or declining market; it becomes more or less liberal in proportion to the demand and readiness of sale. This is one of the main difficulties in the way of prescribing Inspection rules which shall always govern in all localities. At the same time, it is manifestly unjust that a piece of lumber which will pass in a given grade under an advancing market, should rank in a lower grade in a duller market. Many Michigan Inspectors never took kindly to the law as it was written, and varied their Inspection to conform to their personal opinions and judgments, and since its repeal have continued to do so. The tendency of the law was to the side of leniency, favoring the seller rather than the buyer, and its repeal was presumably in accordance with public sentiment, as expressed by the trade at large. It is, however, the only written exposition ever given for the guidance of the trade, and as such it is appended.

Synopsis of the Michigan Inspection Law of 1873.

Sec. 3.—* * * * It shall be the duty of each Inspector General, Deputy and Sub-Inspector, in determining the quality and quantity of lumber inspected by him, to place the same in that class or quality as hereinafter defined, to which it approaches the nearest in description and value, at all times using the description of qualities contained in this act as the standard of comparison.

Sec. 9.—All merchantable White Pine lumber shall be classified as follows, for purposes of Inspection: First Clear, Second Clear, Third Clear, Common and Shipping Culls; and boards six inches wide shall be known as Strips. Norway Pine shall be classified as Common and Shipping Culls, except as hereinafter provided.

Sec. 10.—First Clear lumber shall be not less than eight inches wide, twelve feet long and one inch thick, and at such width, and up to ten inches wide, shall be free from all imperfections. If the width is twelve inches, defects shall be allowed that will equal knots in the aggregate of one inch in diameter, or sap that will be equal to one and one-half inches on one surface. If the width is sixteen inches, defects shall be allowed

that will equal knots in the aggregate of two inches in diameter, or sap that will equal two inches on one surface. If the width is twenty inches, defects shall be allowed that will be equal to knots in the aggregate of two and a half inches in diameter, or sap that will be equal to three inches in width on one surface. The Inspector shall take particular notice and shall allow a due proportion of defects for all pieces of widths between or above the given standards; also shall allow additional defects as the lengths increase above twelve feet, in proportion to such increased dimensions. He shall also allow as follows in each of the three grades of clear lumber, viz: For each additional half inch in thickness, additional defects in proportion that shall equal knots in the aggregate of one-quarter inch more in diameter, or sap that will be equal to one-quarter of an inch more in width. All pieces shall be well manufactured and of full thickness (all knots to be sound), and all sap to be free from black stain that is of such character that it cannot be removed by dressing, and no piece shall be allowed with more than one straight split, and that to be not over one-fifth the length of the piece, which shall be counted as one defect.

Second Clear.—Shall be not less than eight inches wide, twelve feet long and one inch thick, and at such width, and up to ten inches wide, defects shall be allowed that will be equal to knots in the aggregate, of three-quarters of an inch in diameter, or sap that will be equal to three-quarters of an inch in width on one surface. If the width is twelve inches, defects shall be allowed that will be equal to knots in the aggregate of one and a half inches in diameter, or sap that will be equal to three inches in width on the edges. If the width is sixteen inches, defects shall be allowed that will equal knots in the aggregate of two and a half inches in diameter, or sap that will be equal to four inches in width on the edges. If the width is twenty inches, defects shall be allowed that will be equal to knots in the aggregate of three inches in diameter, or sap that will be equal to five inches in width on the edges. A straight split shall be allowed in this quality as before provided in boards of the width of twelve inches or over, and be counted as one defect.

Third Clear.—Shall be not less than seven inches wide, twelve feet long, and one inch thick, and at such width, and up to ten inches, defects shall be allowed that will be equal in injury to a knot one and one-half inches in diameter, or sap that will be equal to one and one-half inches in width on the best side. If the width is twelve inches, defects shall be allowed that will be equal in injury to a knot of two and one-half inches in diameter, or sap that will be equal to two and one-half inches wide on the best side. If the width is sixteen inches, defects shall be allowed that will be equal in injury to a knot of four inches, or sap that shall be equal to four inches wide on the best side. If the width is twenty inches, defects may be allowed that will be equal in injury to a knot five inches

in diameter, or sap equal to six inches on the best side, but sap in no case to exceed one-half the surface on the poorest side. In this quality shall be included pieces ten feet long and not having more than their due proportion of defects; also all pieces six inches wide and more than one inch thick, with not more than two small, sound knots, or sap not more than one inch in width on one side.

First Clear Strips.—Shall be six inches wide, one inch thick, and not less than twelve feet in length, and free from all imperfections.

Second Clear Strips.—Shall be the length, width and thickness of First Clear, and may have two small, sound knots, or if no knots then sap equal to one inch in width on one edge of one side.

Third Clear Strips.—Shall be of the width and thickness of First Clear Strips, and may have three small, sound knots, with sap one inch on one side; but if no more than three small, sound knots, then sap equal to two inches on one side may be allowed; to be free from rot, shake or split. First and Second Norway Strips of full width and thickness, and First and Second Clear White Pine Strips, ten feet in length, also First and Second Clear Strips rejected on account of thickness, and not less than five inches wide, shall be classed in this quality.

Common Lumber.—Shall include all Boards, Planks, Scantling, Strips, Joist, Timber, and lumber not otherwise defined, which is not as good as Third Clear, but is generally of a sound character, well manufactured, of full thickness, and free from large, loose knots and bad shakes, that show on both sides of the piece. Scantling, Joist and Timber must be free from imperfections which so weaken the piece that it cannot be used for substantial building purposes. Scantling, Joist and Timber made from worm eaten logs, and pieces with a small streak of rot, when not so badly damaged as to render the same unfit for ordinary uses of common lumber, shall belong to this quality. One straight split shall be allowed, provided it does not exceed one-quarter the length of the piece. Pieces that have not more than two auger holes, which are placed near the end of the piece, shall be allowed in this quality, provided they are measured in lengths of even number of feet between said auger holes, and conform in all other respects to the requirements of this quality. No lumber under ten feet in length shall be considered as merchantable.

Shipping Culls.—Shall constitute the lowest grade of merchantable lumber, and shall include all lumber not as good as common, which can be used for ordinary purposes without waste of more than one-half.

Mill Culls.—Shall include all lumber not as good as Shipping Culls. A board or plank over twelve inches in width, of which one end shall be wider than the other, shall be measured at a point one-third its length from the narrow end, to determine its width, and all such boards or plank less than twelve inches in width shall be measured at the narrow end.

All lumber over ten feet, up to and including twenty feet, shall be measured in lengths of even number of feet, and all over twenty feet long, each additional foot shall be counted, unless otherwise agreed between buyer and seller. No fractional part of a square foot shall be counted except in the measurement of joist, scantling or timber.

Sec. 11.—Merchantable lumber may be measured and inspected in either of the three following classes, viz: The first class shall be an inspection of the lumber in the five qualities aforesaid.

The second class shall be an inspection of the lumber in three classes, of which the first, second and third class shall form one, which shall be denominated Uppers, and the other two shall be Common and Shipping Culls as aforesaid.

The third class of inspection shall be in one quality which shall include the five qualities first mentioned, and shall be denominated Straight Measure.

SAGINAW INSPECTION.

While the preceding chapter reproduces the enacted law which for three or four years prescribed what should be the rule of inspection in the state of Michigan, it is an undeniable fact that Saginaw was a law unto itself, and while ostensibly working under the provisions of the written law, the inspection of that section was in reality unchanged from preceding systems, to which customs the inspectors mainly adhere to-day.

The same designations of Good, or Uppers, Selects, Common and Culls are retained, or lumber is sold log run (mill culls out) as prescribed in the last section of the defunct law. The main difference between the old Michigan law and Saginaw Inspection proper, is in the former being more in favor of the seller, while the latter is in favor of the purchaser of lumber, and the difference is confined to the higher grades.

The difference may be noted as follows: In the three uppers the Albany rule is more nearly adhered to.

First Clear.—Is not less than eight inches in width, and is free from imperfections, the term Clear implying freedom from defects.

Second Clear.—Not less than eight inches in width, at which it must be so nearly perfect as to fall but a trifle short of First Clear. As the width increases, a larger range of defects may be allowed, so that at twelve inches wide, a piece may have two knots of one inch diameter, or two narrow saps on one side; at sixteen inches wide, especially if the piece is more than one inch thick, two knots may be allowed, or one knot and one sap not over one and one-half inches in width. At twenty inches in

width the two knots may be larger, or the saps may widen to one and one-half inches.

Third Clear.—Is supposed to admit of three defects, but up to ten inches, knots should not exceed three-quarters of an inch in diameter, or sap not exceed three-quarters of an inch on one side. With increasing width knots may increase to three in number, not exceeding in size one inch each, or sap equal to one and a half inches in width on two edges of one side; with narrower saps a small knot showing on the face side might be allowed; but as a rule the three upper grades demand one perfect face. As in all other markets, the inspector is supposed to exercise a wide range of judgment in the inspection of the three uppers. A plank two inches thick and thirty inches wide will admit of a more lenient judgment, as regards defects in size and number, than a piece of half that size or of one inch thick.

A piece of soft cork pine, of free grain and generally handsome appearance, must not be judged with equal harshness with a piece of glassy texture, tough grain and unfavorable appearance.

An experienced inspector will in all cases judge of a piece of lumber from the standpoint of the location of its defects, and the general utility of the piece. While not more than three defects should as a rule be included in the three upper grades, no one would deny that a wide plank with even five knots located near one side, or even some of these showing through to the face, but where perhaps four-fifths of the plank is "clear as a hound's tooth," is deserving of classification in this grade. In reality, the inspection of lumber in uppers consists in defining what constitutes Third Clear, as, in practice, First and Second Clear is ignored, and the number and character of the defects which may be passed in Third Clear, determines the character of the Three Uppers. But in Saginaw and some other markets the term "Good" is used in designating the upper grades, and purchases are sometimes made in "Good," "Selects," "Fine Common," Common and Culls; yet, unless these terms are specified, the quality "Good" in common use will include not only the Three Uppers, but as well the next grade below, or Selects.

Selects.—This term allows of four defects in a piece of lumber. Four knots the size of from a dime to a quarter of a dollar, according to the size of the piece, or two saps on one side which, twelve inches wide, should not exceed three inches in the aggregate, or embrace more than one-quarter the sap side, the heart side being the face. With increasing width the proportion of sap may increase, or with narrow saps, the face side may have some knots. The general description of this grade, however, is of a class of lumber which has defects, of such a character, as, while condemning it for the Three Uppers, yet mark it as suited for many or most uses to which the Three Uppers may be put; the fact that it is usually

combined under the term Good, with the Three Uppers, showing it to be more nearly allied to them than to the lower grades. The dividing grades between the Three Uppers and Common was originally known as Fourths and the designations were Good, Fourths, Common and Culls. When, however, it became incorporated with the Three Uppers, and was included in that designation (as it has practically become) the grade Selects which had hitherto classed with the Common, was admitted to the code, and consisted of what had hitherto been looked upon as raising the Common to a higher standard of excellence. A board twelve inches wide with a perfect heart side, and the bright sap covering half or more of the sap side, would be a Select.

Fine Common.—Also sometimes known as Select Common, or Select Box, or where the designation is thoroughly known, Box, is a grade of lumber suitable for finishing purposes, yet having too much sap on one side, or too many knots on the other, to admit its entry to the grade of Selects. Fine Common is usually taken from the lumber cut next to the outside of the log, sometimes known as sap boards, the general character of which is to give one face side, while the other is largely covered with sap, which, if properly piled so as to dry without mould, is adapted to a large proportion of the finer work where one side only is exposed to view. With this point in mind the inspector will allow knots in this grade proportioned to the size of the piece. If the sap is narrow the face may have one or two small knots, but, except in wide lumber, the rule is observed "one side a face." Pieces below eight inches in width are seldom accepted in this grade, and at that width the defect is in sap, which may embrace not more than one-third the sap side and must not run on to the face side; or a board of that width may have a good sap side, nearly if not wholly clear of knots, and with or two small knots on the heart side. In larger pieces a board or plank having too many defects for the grade of Selects, and yet approaching almost to the requirements of that grade, is included in the Fine Common. A board sixteen inches wide, one inch thick, with five knots the size of one inch, and no other defect, would be classed with Fine Common. The same piece at one and one-half or two inches thick would probably by most inspectors be classed as Selects. Shaky lumber is not admitted in this or the upper grades. Fine Common is substantially the same as Chicago B Selects.

Strips, First Clear.—Are six inches wide, and one inch thick, and free from all imperfections, and are known as clapboard or siding strips. The term siding strips should not be confounded with "Sidings" lumber cut from the side of a log, in distinction from the stock, or lumber cut from the square log.

Strips, Second Clear.—Approaches A Flooring, Chicago yard grading. Six inches wide, one inch thick, and may have two small, sound

knots, or if no knots, then sap equal to one inch in width on one edge of one side.

Strips, Third Clear.—Nearest to B Flooring, Chicago yard grading. Six inches wide, one inch thick, and may have three small, sound knots, and upon one side in addition, sap equal to two inches in width. All strips in these three grades must be free from rot, split or shake.

Norway Strips.—Answering to the description of First and Second Clear, and ten feet or more in length, are included in this grade when sold as Norway.

Strips, Flooring and Fencing.—Include all strips not as good as Third Clear, yet free from rot and split. Flooring strips must be of full thickness and width, except where a narrower width is desired, when they may be of the uniform width of three, four or five inches. All knots in Flooring strips must be of a sound character. Fencing strips include all coarse grade strips not good enough for Flooring, and above the grade of Culls, or strips not up to the standard thickness, and their inspection is less rigid than the other grades.

Common.—The term common includes all boards, plank, scantling, strips, joist, timber and lumber not otherwise defined, which does not come up to the standard of Select Box, but is of a generally sound character, well manufactured, of full thickness, and free from large, loose knots, and bad shakes. Scantling, joist and timber must be free from knots or imperfections which involve or weaken the piece for substantial building purposes. Worm holes and small rot streaks, in extent not materially to damage the piece for the uses in which its size is usually employed, belong to this quality. One straight split, not more than one quarter the length of the board, may be allowed. Auger holes (almost unknown in Saginaw) are to be excluded, by measuring in even feet between the holes. No lumber under ten feet in length is considered as merchantable in this or the better grades.

Shipping Culls.—Unsound knots, or knots which affect the strength of the piece, black or mouldy sap, unsound hearts, bad splits, badly sawed lumber in wedges or tarves (uneven edges), where the piece is yet available for coarse use, and all lumber not up to the grade of common, is included in this grade. Anything poorer than shipping culls is not recognized in any market.

Saginaw lumber is always manufactured in twelve, fourteen and sixteen feet lengths (with an exceptional log of other lengths) in all grades, except dimension stuff, where lengths are cut to suit the sizes demanded, but the sidings from such logs are usually cut off to the twelve, fourteen and sixteen foot standard.

The thicknesses of the Saginaw lumber, as usually cut, are one inch, one and a quarter, one and a half and two inches, but with some three inch

in coarse plank for road or paving purposes, or in extra nice stock, for thick uppers or deals. All lumber is manufactured in parallel widths, and many mills employ cut-off tables for reducing all lengths to uniformity.

The coarser grades are almost uniformly cut one inch thick, the better grades almost invariably in the one and one-half and two inch thicknesses.

CHICAGO CARGO INSPECTION.

Adopted by the Lumberman's Exchange.

This may be termed a modification of the combined Albany and Saginaw Inspections. It is observed in the sale of cargoes on the Chicago wholesale market.

Section 1.—First Clear or White Pine Lumber shall be not less than twelve inches in width, and no imperfections allowed unless fourteen inches wide or upwards; will then allow imperfections equal to sap, one inch on one side, extending the whole length of the piece, on pieces fourteen inches wide and well manufactured, but the face side must be perfect; as width increases, will allow larger imperfections in proportion to the width, but not imperfections enough to decrease the value below the above described piece.

Sec. 2.—Second Clear White Pine Lumber shall be not less than ten inches wide and perfect up to eleven inches in width; will then allow imperfections equal to sap one inch on one side of the whole length of the piece, if well manufactured; as width increases, will allow other and larger imperfections in proportion to the width, but not imperfections enough to decrease the value below the above described piece.

Sec. 3.—Third Clear White Pine Lumber shall be not less than nine inches in width, and perfect up to ten inches; will then allow imperfections equal to sap, one inch on one side of the whole length of the piece, if well manufactured. The imperfections of this quality shall not exceed 100 per cent. over those allowed in Second Clear.

Sec. 4.—Select White Pine Lumber shall include all lumber poorer in quality than Third Clear, the imperfections of which shall not exceed 100 per cent. over those allowed in Third Clear.

Sec. 5.—Clear White Pine Flooring shall be one inch thick, six inches wide, and no imperfections.

Sec. 6.—Second Clear White Pine Flooring shall be in thickness and width same as Clear Flooring, and will allow of one small knot or sap three-quarters of an inch on one side, with clear face.

Sec. 7.—Common White Pine Flooring shall be of the width and thick-

ness of First or Second Clear Flooring, and may have three small, sound knots, with sap one inch on one side, but if less than three knots, then sap equal to two inches on one side, and shall be free from rot, splits and shakes. Four inch flooring strips, equal in quality to First and Second Clear Flooring, shall be classed as Common six inch Flooring.

Sec. 8.—Common Pine Lumber includes all boards, plank, joists, scantling, timber, fencing, and four inch strips that are of generally sound character, well manufactured, and not included in the foregoing qualities. Boards and plank should be square-edged, full thickness, and have no large, loose knots or bad shakes. In wide boards, twelve inches and over, will allow a straight split one-sixth the length of the piece, when otherwise sound. Fencing should be of good, sound character—pieces that will not break easily, six inches wide and one inch thick. Scantling, joist and timber should not have imperfections that would weaken the piece so that it cannot be used for substantial building purposes, and be uniform in width and thickness. Lumber should be measured at the small end, and if much wane on the piece, reasonable allowance made for it. Norway Pine Lumber shall be classed as common lumber, unless otherwise agreed upon. Cargoes of piece stuff or timber containing over twenty-five per cent. Norway, shall not be considered standard, and all edge boards and inch lumber in cargoes of piece stuff shall be subject to special agreement.

Sec. 9.—All badly stained white pine lumber, that is otherwise better than Common, shall be inspected into a lower grade than when bright and free from stain.

Sec. 10.—All lumber described in the foregoing rules of Inspection shall be not less than one inch in thickness, and not less than twelve feet long.

Sec. 11.—Culls. A quality that cannot be received into any of the foregoing, consisting of even lengths, of ten feet and upwards, and so imperfect as to be unfit for ordinary uses without waste.

Mill Culls.—Refuse lumber.

Sec. 12.—All cargoes sold under straight measure shall consist of lumber twelve feet and over; and where, by imperfection of manufacture, such lumber is reduced in grade so as not to answer the purpose for which it was intended, it shall be measured at only one-half the amount in the piece for which it was intended. And all pieces containing auger holes, if fourteen feet in length and over, and bored only at the ends, shall be measured in full, excluding two feet in length of the piece; if bored in the center, it shall be measured for only one-half the amount in the piece. All lumber less than twelve feet to be subject for special contract between the parties. Mill Culls excluded in all cases. All boards and strips to be at least one inch thick; joists or scantling two or three inches thick,

Sec. 13.—Lath—Number One—should be four feet (no more, or less), in length; not less than three-eighths of an inch thick, and one and one-half inches wide, free from shakes, rot, wane, or worm-holes.

Number Two—same length as No. 1, may be less than three-eighths of an inch thick, and must be not less than one and one-quarter inches wide, will admit of wane and worm-holes not to exceed ten pieces in a bundle of one hundred.

Culls—All that will not pass in the above named qualities.

Shingles—All pine and cedar shingles shall be not less than sixteen inches in length, and three-eighths inch thick at the butt, and shall be classed and known as follows:

The first grade is to be denominated Clear, and to consist of shingles not less than three inches in width, all to be absolutely perfect.

The second grade is to be denominated Extra A, and this shall consist of shingles not less than three inches wide, and with the butts clear for ten inches of the length.

The third grade to be denominated Standard A, and to be not less than eight inches clear from the butt, and not less than three inches wide.

The fourth grade to be denominated Shaded A, the shingles to be clear for a distance of not less than five inches from the butt.

The fifth grade to be denominated No. 1, and to include everything poorer than Shaded A, but to be made of sound timber, with no unsound knots in the butt.

Culls—Are a quality manufactured from winding, worm-eaten, shaky or dry-rot timber, badly manufactured or less than sixteen inches in length.

It is recommended that one-quarter thousand bunches be packed in bands twenty inches in length, with twenty-five courses; one-half thousand bunches in twenty-five inch bands with forty courses. Shingles shall always be full count, and pay shall be collected only for the number of shingles actually delivered, regardless of the pretended number contained in each package or bundle; or, in other words, there shall be exacted in every instance for one thousand shingles, the equivalent of one thousand pieces four inches wide.

These rules, for the grading of shingles, were adopted by the Lumberman's Exchange, April 12, 1880.

CHICAGO YARD GRADING.

The system of grades prevailing among the yards of Chicago, is a most difficult thing to describe, yet a general similarity of ideas is supposed to prevail among all dealers. We therefore endeavor to give the general laws governing their grading.

First Clear.—Shall be not less than twelve inches in width and twelve feet long (except that in some yards ten foot pieces are admitted in the upper grades, the majority adhering to the twelve foot standard), and with no imperfections, unless the piece is fourteen inches or over in width; will then allow imperfections equal to sap one inch on one side, extending the whole length of the piece, but the face must be perfect. As the width increases, will allow larger imperfections in proportion to the width.

Second Clear.—Shall be not less than ten inches wide, and must be perfect up to eleven inches. Above eleven inches, imperfections may be allowed equal to sap one inch on one side of the whole length of the piece, if well manufactured. With increasing width will allow other and larger imperfections in proportion to the width, but not imperfections enough to decrease its value beyond the standard of a twelve inch piece of above description.

Third Clear.—Shall be not less than twelve inches in width (except as below), and perfect up to ten inches; will then allow imperfections equal to sap one inch on one side of the whole length of the piece, if well manufactured. This grade, however, is subject to modification in that while it is mainly the equivalent of Albany Thirds and Selects, it may generally be found to combine the grades of A Box, A Stock and eight-inch A, varying from standard inspection by allowing a minimum width of nine inches and a length of twelve feet. In yard grading, knots as big as a half dollar may be allowed in a fair sized piece, as to general location and effect upon the use of the board. Smaller knots, as high as five in number, or bright sap on each edge of one side, two inches in width. In narrow boards, one face must be nearly perfect except eight inch A, where the general rule applies, modified by the width. A Stocks, usually refers to twelve inch, but may apply to ten inch Stocks when so specified.

B Box and A Stocks.—Usually range in price with Third Clear. Eight inch A, although of the same general quality, ranges from $3 to $5 lower in price. Ten inch Stocks in all grades usually range $2 below twelve inch.

A Selects, B Stock, Eight Inch A and B.—These are all of about

one grade, and are taken from Third Clear and Selects, which may be called "line boards, between the two grades.

A Select.—Is properly a grade below, although some claim to make it equal to Third Clear. In this grade, some yards will allow shake, where the use and general value of the piece is not seriously impaired thereby. As a rule, however, no shake is admitted. Knots may be allowed according to size of board and location of knots, but seldom both knots and shake. Widths may run from eight inch upward. Sap may be allowed equal to two inches on one side of a nine inch piece, increasing with the width. The term "Box" is applied to all grades, where the width makes the lumber suitable for cornice and shelving, or wagon-box boards, from which latter the Chicago use of the term is derived. Sample boards may be described as follows: A board twelve feet long, twelve inches wide, had one knot the size of a dime, one cat-face knot, two saps on one side, of which one is narrow, running the whole length, the other three inches at one end, tapering out at four feet. Some call this a fair, others a good, A Select.

B Box.—Is thirteen inches wide and over. A board seventeen inches wide, sixteen feet long, with twelve medium knots; another sixteen inches wide, two saps of two inches each on one side, and ten small knots on the other, were seen in a pile of B Box, but were criticised by other graders.

B Stock.—Is usually twelve inch, but may include ten inch stocks. Eight inch B is of parallel width (seven and one-half to nine) up to grade, in proportion to width.

B Select.—In general character is a sap board; if narrow, one side may be well covered with sap, no knots on the face. Such a board may be from seven to ten inches. At ten to fourteen inches, some knots and less sap. This class makes good "one side" lumber for finishing boards, and in general, knots may be allowed of a character not to injure the board for finishing purposes or for cutting up. A sample board seven inches wide had bright nearly covering one side, the other a face. Another of thirteen inches had but four inches of meat on the sap side, the sap came through to the face, and there were two small knots on the face. Another of nine inches had sap covering one end for five feet, sap ran slightly on to the face of the board. B Selects on wider pieces may combine some considerable shake at the ends, if the center is good, or on center if the ends are good.

The sap in this grade should be judged in the matter of color by its surroundings. While a black sap is scarcely allowable, a simple discoloration will not condemn the piece if all other requisites are present. A piece of fair width with one clean face to work would admit of a blacker sap on the outside of cut. In this grade also may be admitted a class of soft wide lumber, with large or even loose knots, where the cuts between the

knots may give a large proportion of finishing lumber. Such lumber is often found where the rules of regular and strict inspection would condemn a piece to the grade of cull, yet where the piece is of especial value for cutting up. This grade is substantially the same as the Fine Common of the Saginaw Valley.

Common.—All good sound lumber, ten feet long and upwards, however knotty, if the knots are tight and sound and not coarse enough to weaken the board, are included in this grade. Also sap boards, when the sap is fairly bright. Boards free from rot and shake, which involve their usefulness, are common boards. Lumber which will make a water-tight roof is in all markets included in this grade. Splits or Checks, if straight and not of an extent or nature to materially injure the board, are generally allowable. Bad splits and checks, especially when not straight, will always condemn a board of any grade to a lower one, according to the effect upon its usefulness. The same is true of waney edges. The lumber must be of full standard thickness and well manufactured. Worm-holes may be permitted in this grade in number and character proportioned to the size of the piece, but as a rule, wormy lumber should be excluded as Culls. Custom has allowed common plank, measuring one and seven-eighths inch thick, to be measured as if full two inch. A few worm-holes are not objectionable in dimension stuff, unless enough in number to weaken the piece, or of a generally unsightly character.

C Box.—Is a grade of thirteen inches wide and over, with small, sound knots.

D Box.—Is simply good, wide Common.

Neither of these last two pretend to any grading above Common, except that their widths adapt them to special uses.

Stock Boards.—A class of lumber sawed of a uniform width of ten, twelve and fourteen inches. It is graded the same as other lumber, but its uniformity marks it as of superior utility for ripping into flooring, siding etc., or for manufacturers requiring large quantities of certain widths for special work. The lower grades are mainly used as barn boards or for coarse sheathing, and other similar purposes.

Other Varieties.—Norway mixed with other lumber uniformly classes as common; but when in lots by itself, may be graded in a manner similar to white pine, the designation "Norway" indicating its distinctness from white pine.

Flooring, siding and ceiling are graded according to the general rules applying to wider lumber, modified to suit the decreased width, but are measured as the piece was in the rough.

First and Second Clear Strips and Siding.—No. 1 is perfect in thickness, width and quality. No. 2 will allow of a narrow, bright sap on one side, or one or two small sound knots. The two are usually combined.

A, or First Common.—If free from sap may have two or three small sound knots, or bright sap one-half or three-quarters inch.

B, or Second Common.—May have three or four medium size sound knots, or bright sap of one to one and a quarter inch.

C, or Third Common.—May have two to six medium knots, or two to three inches of sap, or both sap and knots to equal these.

Flooring, A or First.—Should have one face nearly clear, with but one or two small, sound knots; the other may have more knots or sap.

B, or Second.—May have two to four sound, medium knots, and bright sap equal to one or one and a quarter inches.

C, or Third.—Will allow of three to six small, sound knots, or one and a half to two inches bright sap.

Fencing Flooring.—Is good, common flooring from selected fencing, and may have a large number of small, sound knots, but the general character of the piece is such as to make a good floor, practically free from shake and loose knots.

Fencing, No. 1 or Common.—Sound knots, not to weaken the piece; may have considerable sap. No. 2: black sap, coarse knots, shaky or otherwise defective, yet not so as to prevent its use as coarse fencing. Four inch lumber of any grade should have one-third less imperfections than is allowed, on six-inch widths. Norway of the same general quality is scrutinized much more closely than white pine.

Deck Plank.—Is lumber suitable for decking for vessels, and is usually three, four, five and six inches wide, and three to four inches thick, and the greater the length the more valuable is it considered. No lot averaging under twenty-five to thirty feet in length is properly classed as decking. This should be almost wholly free from sap, must be free from shake, but may have any reasonable number of small, sound, red knots. It is sometimes used two and a half inches in thickness.

Culls.—Unsound lumber, loose knots, bad, black knots, or large, coarse knots, loose or shaky hearts, unedged or waney and badly shaky lumber, black sap stain, especially if mouldy. All wormy lumber, rotten streaks, or ends badly manufactured as to thickness, wedge boards or tarved lumber (thick on one edge and thin on the other), or boards which won't hold water. All the above properly belong in Culls, and when unfit to be used as roofing to nail shingles on, or is generally unsightly in appearance, it is known as "Scoots," Refuse, or Mill-Culls, and has no quotable value.

Lengths.—In some yards ten feet is the standard of length, and all lumber is measured in even figures of ten, twelve, fourteen, sixteen and eighteen feet; odd lengths are unknown unless in special orders and in lumber of over twenty feet. Until within the last two years twelve feet was the minimum of length in a merchantable piece of lumber, and most yards yet adhere to this rule. All lumber of less than ten feet is unsal-

able, except when in quantities, as it is often found in irregular lengths at gang saw-mills, when it is known as "clips." This is sometimes sorted as to quality, but has no classification; it is usually sold as a bulk, either by the pile or by straight measure, and is often of a desirable character for builders.

Widths and Thickness.—The wider a board is the more latitude is allowed for defects. This remark applies generally to lengths, widths and thickness, although as a rule, unless a board holds plump to an intended thickness, it is measured to the next standard below. In dimension, or bill stuff such as joist, scantling or timber, a variance in thickness is almost universally allowed by dealers and consumers, although strict rules of inspection demand full sizes in all respects.

In wholesale markets a board measuring a half inch or more over a certain width is measured at the next lower number. In retailing, however, the half inch is properly counted, while in some markets the "give and take" principle is observed; that is, if a full half inch or over, it is called at the next higher figure; if not full half inch it is called back to the last full figure.

The following table shows the average weights obtained in the actual shipment from Chicago of 20,000,000 feet of pine lumber, during an entire season:

	POUNDS.
1, 1¼ and 1½-inch, surfaced one side	2,102
The same, surfaced two sides	2,068
2-inch, surfaced one side	2,200
White pine flooring, dressed and matched	1,890
Hard pine flooring	2,366
Ship lap, 8-inch	1,711
Ship lap, 10 inch	1,725
Ship lap, 12-inch	1,855
White pine, ⅜-inch ceiling	786
Hard pine ⅜-inch ceiling	950
Siding	865
Piece stuff, rough	2,560
Piece stuff, surfaced one side and one edge	2,210
Thin clear, surfaced one side	1,380
⅝ ceiling	1,120
Rough boards	2,524
Hard pine fencing	2,910
4-inch flooring, dressed and matched	1,793
6-inch fencing	2,433
Pine shingles	248
Cedar shingles	203
Dry lath	502

CHICAGO HARDWOOD INSPECTION.

The Chicago rules of Hardwood Inspection do not materially differ from those in vogue in other localities, although, as in the case with pine, there are many points which are the subject simply of judgment, and cannot be defined even in conversation, inasmuch as scarcely any two pieces of lumber are exactly alike, and each piece must be the subject of an individual and distinct opinion. The ensuing description has been carefully revised by the leading dealers in hardwood in Chicago, and meets their approval as laying down the general rules and practices of this market.

The forest products embraced in the term hardwood, as known to the trade here, include Poplar or Whitewood, White Ash, White, Red and Burr Oak, Hickory, Black Walnut, Cherry, Butternut, Hard Maple, Soft Maple, Basswood, Hickory or Rock Elm, Sycamore, Sweet Gum, Chestnut, Red Cedar, and Southern or Yellow Pine.

POPLAR.

Poplar should be in even lengths of twelve, fourteen or sixteen feet; anything shorter must be very good, and submit to an allowance in price. The principal thicknesses are ½ inch, ⅝ inch, ¾ inch, 1 inch, 1¼, 1½, 2, 2½, 3, 4, 5 and 6 inch. Squared should be 4x4, 5x5, 6x6, 7x7, 8x8, 9x9 and 10x10, and should in all cases be ⅛ inch over these inches, to allow for shrinkage in drying; ½ and ¾-inch are special sizes.

The Inspection grades are Clear or No. 1; Second Clear or No. 2; Common or No. 3; and Culls.

First Clear, or No. 1.—Must be twelve inches or more in width, and free from all defects. The squared pieces are exempt from this rule only as to width. Plank from 1¼ inches in thickness may be of a width of ten inches. Bright sap not over two inches would be allowed in this grade.

Second Clear, or No. 2.—May be eight inches wide and upward, but at ten inches may have from one to three sound knots. If a piece is wide, a little white sap may be allowed on one side. All narrow, perfect pieces of eight inches are placed in this class. Defects are counted upon the basis of a knot the size of an English walnut (about 1¼ inch diameter), with an allowance of more defects in proportion to increased width. Splits will always drop a board into the grade below.

Common, or No. 3.—May be of any width or thickness. Will allow of discolored sap, sound knots, beyond those described in No. 2, and wide saps. In narrow pieces, not more than three knots will be allowed. De-

fects may increase in number and extent as the width increases, but all lumber must be sound.

Culls.—All widths and sizes having more defects than described in Common, whether in the number or character of the knots, discolored sap, badly checked, and generally such lumber as is unfit for ordinary purposes without waste.

WHITE ASH.

White Ash should be in lengths of twelve, fourteen and sixteen feet, and the usual thicknesses are 1, 1¼, 1½, 2, 2½, 3, 3½ and 4 inches. It is inspected in Nos. 1 and 2 combined, and Cull, price being made as to character or preponderance of the better or poorer. Sap is not considered a material injury. Ash lumber is to be eight inches wide and over; at eight inches defects may be allowed equal to two small hard knots, 1¼ inch being taken as a standard. Must be free from hearts and dry rot. All sizes must be ⅛ plump, or will be reduced in grade and price. Wagon tongues should be cut from tough timber, butt logs, and be free from defects of any kind, especially cross grain; length, twelve feet; size, 2x4 at one end by 4x4 at the other, and 2½x4½ at one end by 4½ square, plump, at the other. Splits reduce one grade.

Cull Ash.—Includes all defective lumber, hearts, shakes, knots beyond standard, dead or doty timber, and defective sawing.

Ash Flooring.—Should be four and six inches wide, with one face and two edges clear; thickness, 1 and 1¼ inches; lengths, twelve, fourteen and sixteen feet.

WHITE AND BURR OAK.

Lengths should be twelve, fourteen and sixteen feet. Sizes 1, 1¼, 1½, 2, 2½, 3, 3½, 4 and 4½ inches. Shorter lengths may be allowed, but are subject to an allowance in price.

It is inspected as Clear, Second Clear, Common, Culls, and Wagon Stock. Some yards do not make the grade of Second Clear, that grade enriching the Common.

Clear.—Must be eight inches wide and over, free from all defects.

Second Clear.—At eight inches wide will allow from one to three small sound knots, of the 1¼ inch standard, or a little bright sap. No other defects are allowed in this grade but their extent may increase with the size of the piece. Splits always reduce one grade in oak as well as in other hardwoods.

Common.—Must be free from shake and worm holes; may have sound heart in thick plank. All knots must be sound.

Culls.—Bad heart plank, wormy or generally unsound lumber.

Oak Flooring.—Should be four and six inches wide, with one face and two edges clear; thickness 1 and 1¼ inches; lengths, twelve, fourteen and sixteen feet.

OAK WAGON STOCK.

Bolsters.—Should be four feet and four feet six inches, or the multiples thereof in length. The sizes run 3x4, 3½x4½, 3½x5 and 4x5.

Reaches.—Require plump thickness, 2x4 and 2½x4½. Lengths, eight, ten and twelve feet, clear of imperfections.

Harrow Timber.—Thickness, 2½x2½ and 3x3 plump. Lengths may be five, ten, twelve and fourteen feet. Must be clear of imperfections.

All stock should be sawed one-eighth plump, and bolsters should allow three inches for check in seasoning.

HICKORY WAGON STOCK.

Hickory may be classed as Boards, Plank and Axles.

Boards and Plank.—Are inspected as First and Second Clear, in one grade.

The lengths are ten, twelve, fourteen and sixteen feet; the thicknesses, 1, 1¼, 1½, 3, 2½, 3 and 4 inches.

The combined grade will not admit of more than one or two small, sound knots of the one and one-fourth inch standard, and no other imperfections. Sap is excluded from yard piling and grading from its liability to powder-post in seasoning.

Axles.—Lengths are six and twelve feet. Sizes, 3x4, 3½x4½, 4x5, 4x6, 4½x6, and 5x6. Must be sawed plump, one-eighth inch full, and perfect in all respects.

Culls.—All lumber not up to the preceding grades.

Hickory should never be cut between the first of February and first of September, while the sap is rising.

BLACK WALNUT.

Lengths may run twelve, fourteen and sixteen feet, but as short as eight feet is taken if otherwise up to grade, with due allowance as to price. The usual thicknesses are ⅝, 1, 1¼, 1½, 2, 2½, 3, 4 and 5 inches. Width is a desirable point in walnut.

It is handled in numbers one and two combined.

No. 1.—Must be not less than eight inches in width, and must be free from all defects.

No. 2.—Must be not less than seven inches wide, and at seven inches may have a little sap, or two small knots of not over one inch standard. Defects may increase with the width in proportion.

Common.—All not up to the standard of number two, but available in its full size without waste.

Culls.—Any width, not good enough for common, in which not less than one-half the piece is fit for use without waste.

Walnut Flooring.—Is one inch in thickness and four and six inches

in width. The six inches allows for splitting into narrower, when dressed, without the risk of warping in seasoning, which would destroy the value of narrower sawed stock. Must have one face and two edges clear.

Newels.—Should be cut outside the heart, to square five, six, seven, eight and nine inches when seasoned. Their length should be four feet or the multiples thereof, and they must be free from all defects; curls rightly located are not considered defects.

Balusters.—Should be cut exactly square, 2x2, 2¼x2¼, 2½x2½, 3x3 and 4x4, and a full one-sixteenth plump. Lengths, thirty and thirty-two inches. Must be free from all defects, especially sap and shake.

Counter Tops.—Are twelve, fourteen, sixteen and eighteen feet in length, twenty inches and over in width, and strictly clear. The longer lengths are the most desirable.

In fourteen and sixteen feet lumber, ends may be cut where a twelve foot length can be obtained.

CHERRY.

The inspection is in grades of Firsts and Seconds, and is the same as in Walnut, and the same rules apply. Thicknesses may be 1, 1¼, 1½, 2, 2½, 3, 4 and 5 inches. Lengths, twelve, fourteen and sixteen feet. Widths, eight inches and over. Cherry flooring, newels and balusters same as Walnut.

BUTTERNUT.

Same as Walnut and Cherry, in grades of Firsts and Seconds. Lengths, twelve, fourteen and sixteen feet. Thicknesses, 1, 1¼, 1½, 2, 2½ and 3 inch. Widths, eight inches and over.

HARD MAPLE.

Is inspected in a combined grade of Firsts and Seconds.

Lengths may run twelve, fourteen and sixteen feet. Thicknesses, 1, 1¼, 1½, 2, 2½, 3, 4 and 4½ inches. It must be not less than eight inches wide, at which one small (1¼ inch) sound knot may be allowed, but no other defects in the first grade. Increased defects may be allowed with increased widths, if located so as not to injure the cutting of sizes for which each thickness is adapted. Some yards divide into Clear, Common and Culls. The Clear must be ten inches and over, and free from all imperfections. Splits will reduce one grade in each quality.

Common.—May be from six inches upward, with imperfections which will not render the piece unavailable for ordinary uses without waste. Not over two or three small knots, without shake, will be allowed in the grade.

Culls.—Include all heart shakes, badly sawed or other defects, from which the piece is not good enough for common, but in which one-half the piece will work up without waste.

Flooring should be cut from the outside of the log from the white timber, the red timber of the heart wood, being less valuable, and should be cut in four and six inch widths, 1 and 1¼ inch thickness, mostly one inch.

SOFT MAPLE.

Is but little in demand, but Inspection is the same as in Hard Maple.

BASSWOOD.

Basswood is used in lengths of twelve, fourteen and sixteen feet. Thicknesses are 1, 1¼, 1½ and 2 inches, the demand being mostly for one inch. Widths may be eight inches and upward. Edges should be square, as in Pine. It is inspected in the two grades of Good and Cull.

Good.—Includes all perfect lumber free from shake, black knots and hearts. Small sound knots, from one to five in number, do not condemn it for this grade.

Culls.—Include all lumber not good enough for the preceding grade. As in Pine, a board which will not work at least one-half its size without waste, is a mill cull, and has no market value. An inordinate number of knots will, in basswood, condemn a piece to the grade of culls.

HICKORY.

Hickory or Rock Elm is used in lengths of twelve, fourteen and sixteen feet, and in thicknesses of 1, 1¼, 1½ and 2 inches. The inspection is in Good and Culls.

Good.—Comprises lumber free from hearts and shakes; small, sound knots from one to five in number, do not condemn it.

Culls.—Comprise all below the grade of good, when at least one-half the piece will work without waste.

SYCAMORE.

Same as Hickory or Rock Elm.

SWEET GUM.

Is inspected the same as Black Walnut. Lengths, twelve, fourteen and sixteen feet; thicknesses, 1, 1¼ and 1½ inches. The demand is mostly for one inch, eight inches wide and over.

CHESTNUT AND CEDAR.

Same as Sweet Gum and Black Walnut.

SOUTHERN OR YELLOW PINE.

In Southern or Yellow Pine this market demands only the best quality, the plentifulness and cheapness of White Pine effectually excluding all of the coarser grades of Yellow Pine. Our remarks, therefore, apply to

the better qualities of Georgia and Florida Pine, or lumber from sections supplying the same character of timber.

It is inspected as First and Second Clear, in thicknesses of 1, 1¼, 1½ and 2 inches. The combined grade will admit of one or two small, sound knots; must be free from other defects. Flooring Strips are of four and six inches width, with one face and two edges clear.

The Hardwood Inspection of Chicago differs but little from that in vogue in other localities. Nearly every description of Hardwood is sold in bulk as Merchantable, as well as by Inspection. In this case the mill culls are thrown out, and the price is made according to the quality of the log run. Large quantities of Walnut, Maple, Oak, Ash, Basswood and Hickory are sold in this way. The sizes, however, should be cut as specified under their respective heads.

ST. LOUIS INSPECTION.

In White Pine and Hardwood inspection the customs of St. Louis are almost identical with those of Chicago, so that it is unnecessary to repeat them. Reference may therefore, upon these points, be made to the chapters on Chicago Gradings or Inspection. Missouri and more southern states, however, ship large quantities of Yellow or Pitch Pine, long leaf, to the St. Louis market, and the customs prevailing at that point are substantially the same, as regards inspection, as those applying to the same timber at other points.

YELLOW PINE.

Yellow Pine Boards are divided into Clear or First Rate, Second Rate, Third Rate and Culls.

Clear.—Must be clear, free from all defects; in lengths of twelve, fourteen and sixteen feet, and the thickness one and one-sixteenth inch. Longer even lengths and greater thickness is allowed, but is usually ordered for special purposes when needed.

Second Rate.—Has one clear face, or may have two defective faces; first, when the defects are limited to a bright sap, not over one inch in width on one or both edges, but without wane; or, second, when the piece has one blue edge or one waney edge, neither being over one inch in width; in both cases the faces being in all other respects clear, with the exception of one or two sound knots, not over one-half inch in diameter, which may show through the piece.

Third Rate.—A grade having more defects than described in Second

Rate, but free from shakes, large unsound knots or rot. Lumber of less than standard thickness is included in this grade.

Culls.—Large unsound knots, shakes or rot.

FOUR INCH STRIPS.

Are graded as Clear or First Rate, Second Rate, Third Rate and Culls. Lengths to be twelve, fourteen and sixteen feet; thickness one and one-sixteenth inch, width four inches full.

Clear or First Rate.—Must be clear, as in wider lumber, and perfect in length, width and thickness.

Second Rate.—Either one perfect face or both faces being in all respects clear, except that it may have two sound knots of not over one-half inch in diameter, which may show through to both sides.

Third Rate.—Will allow of more defects than Second Rate, but free from shake, large unsound knots or rot. Boards below the standard in thickness are included in this grade.

Culls.—Include all large unsound knots, shakes or rot.

SIX INCH STRIPS.

Are graded as Clear, or First Rate, Second Rate and Culls. Lengths twelve, fourteen and sixteen feet; thickness, one and one-sixteenth inch; width, six inches full.

Clear or First Rate,—Are perfect pieces of full length, width and thickness.

Second Rate.—Pine having one clear face, or two defective faces, where the defects are limited upon one face to bright sap not over one-quarter of the width of the board on one edge, or narrow bright sap on both edges, but no wane; or to one blue edge or to one narrow wane. Both faces must in this case be clear, except that three sound knots of less than one inch diameter will be allowed, which may show through the board, provided they lie in a straight line parallel with the edge.

Third Rate.—May have more defects than are described in Second Rate, but must be free from shakes, large unsound knots or rot. This grade also includes lumber below the standard thickness.

Culls.—Boards having large unsound knots, shakes or rot.

STAIR PLANK.

Are ten inches and over in width; twelve, fourteen and sixteen feet in length; sawed to one and one sixteenth, one and five-sixteenths and one and nine sixteenths inches in thickness.

The grading and inspection of Stair Plank are the same as of Boards.

WILLIAMSPORT INSPECTION.

The well known Allegheny region is largely represented by the operators at Lock Haven and Williamsport, Pa., and the inspection customs of the former are governed by the rules of the West Branch Lumberman's Exchange, as is the case in the surrounding country, outside of those two points, where lumber is handled to any extent. As the shipments from this section are largely to Philadelphia and Baltimore, a knowledge of the inspection customs of the producing point, conveys as well an idea of the inspection at the consuming or distributing points. As in all other markets allowance must be made for variation in practice, while the rules are observed as a standard.

RULES OF INSPECTION

Adopted by the West Branch Lumberman's Exchange, and in vogue at Williamsport and contiguous points.

Selects and Better.—Shall include all the better grades which are equal in value to the following described piece: not less than eight inches in width, and perfect up to ten inches in width, except sap, which may be admitted one and one-half times the thickness on the back side.

Above ten inches wide will admit of imperfections equal to three small knots, and sap one and one-half times the thickness on face side; above fourteen inches wide will admit of imperfections equal to sap as above, and larger knots and straight split one-sixth the length of the piece; as the width increases, will admit of greater imperfections, but not enough to decrease the value below the first described piece.

Picks.—This grade shall include all boards below the grade of Selects and better, that shall be equal in value to a piece of from six to nine inches wide, that shall have a perfect face, with back side sound and free from badly stained sap.

Above nine inches wide, will admit of defect equal to sap two inches on either edge of face side, and knots equal to one knot two and one-half inches in diameter.

Above thirteen inches wide may admit of defects equal to sap nine inches in width on either edge of face side, and three knots two and one-half inches in diameter. All boards of this grade above ten inches may admit of straight split, one-sixth the length of the piece, but no board shall be of less value than the first described piece.

Flooring.—Shall include all boards below Picks that shall be five inches in width, with red, sound knots not exceeding one and one-half inches in diameter. Will admit of sap one and one-half times the thickness of the piece, and when above ten inches in width may admit of straight split one-sixth the length of the piece, and should be free from shakes, rot and loose knots.

Third Common or Barn Boards.—Shall include all lumber below the grade of flooring that is of fairly sound character. May admit of straight split one-quarter the length of the piece, and should be free from large loose knots, bad shakes and rot.

Culls and Samples.—Shall consist of all lumber of a generally unsound character, and where the imperfections are too great to allow of the board being used for the ordinary uses of Third Common or Barn Boards. Worthless, rotten lumber should not be counted in this grade.

Pickets.—No. 1. Shall be clear of knots, wane and black sap; not less than seven-eighths inch thick and two and a half inches wide.

No. 2. May include sound knots, stained sap and wane not to exceed one-half the thickness of picket.

Square Pickets to be of same grades.

Lath.—No. 1. Shall be one and a half inches wide, not less than three-eighths of an inch thick, packed in bundles of 100 pieces to each bundle.

Hemlock.—Shall consist of two grades; merchantable and cull hemlock.

Shingles.—Are graded Nos. 1 and 2, and are twenty-four inches in length.

No. 1. Should be clear of sap and knots; five-eighths-inch at the butt and one-eighth-inch at the point.

No. 2. Should be clear at least one-third the length from the butt, but the balance will admit of small knots, if sound, and some sap.

MAINE SURVEY.

Maine was at one time the heaviest producing section in White Pine. Fifty years ago the lumberman of New York, Connecticut and contiguous states, made annual ocean voyages to Bangor and other points in Maine for their supplies of Pine and Spruce lumber and timber, and the hardy lumbermen of that day, or their sons and successors, have been among the most forward and enterprising agents in the settlement of the then unknown forests of the Northwest. Year by year have the forests of Maine yielded to the brawn and muscle of the lumbermen, and the in-

satiate appetite of the saw mill, until to-day the character of the Pine resources of the state is well depicted in the designations which attest the prevailing systems of Inspection. While the quantity of pine is very much reduced, the quality of it has also deteriorated in proportion, and the "Survey" is less to the advantage of the purchaser. Maine still boasts a large supply of Spruce and Hemlock, and will be able to supply these for many years to come. In fact, from the well known rapid growth of Spruce, the state will, for a generation at least, be still able to supply its quota, and one-half the state will always be productive forest as the land is worth more to grow timber on than any other crop, and is only culled, not cleared.

The Survey of Spruce is rather in favor of the purchaser.

PINE.

No. 1.—Is entirely dispensed with, and the first quality now recognized is called No. 2.

No. 2.—This may be of any length or width, provided, however, that the short lengths and narrows must be good; the shorter and narrower the board, the better the quality required. A board twelve feet long and five or six inches in width, must be entirely free from knots and sap, and must be straight in grain. Larger boards must be nearly free from knots, sap and shake.

No. 3.—Must be free from shakes, but a few knots or a little sap will not condemn it. The size of the board goes far to determine this quality; very small pieces otherwise up to grade, would be classed as No. 4.

No. 4.—Is a small board usually free from knots, but with some sap. If large boards are put in this number, it is because one-quarter or one-third of the piece is shaky, although the balance may be good.

The market recognizes, also, two kinds of shipping boards designated "Shippers", viz.: Smooth and Common.

Smooth Shippers.—Are boards without shake or case knots, or any large knots.

Common Shippers.—Are boards coarse and knotty, eight inches and upward in width, and twelve feet and upward in length, (These are sometimes manufactured under special orders, when they may be nine inches, ten inches, or even greater widths.) In this grade splits, red streaks or very shaky boards are objectionable.

Narrows, or Narrow Boards.—Is the next grade to Common Shippers, and consists of boards too small for Shippers. These must not be very coarse; must be suitable for floor boards.

Poor Fours.—These consist of sappy, shaky, or knotty boards, not suited to be classed in either of the foregoing descriptions,

Scoots.—Are the lowest grade; rotten boards and all others not admissable in other grades are surveyed as scoots.

The market also handles what is termed Sapling Pine or Gang Boards. These are usually manufactured in gang mills, the survey as to quality being about the the same as the balance of the grades described, except as to designation, the twos, threes and fours being put together under the one term Planers. The shippers, narrow boards, poor fours and scoots are surveyed as described in those heads.

Gutter and Deck Plank.—The rule last described is also applied to gutter and deck plank.

SPRUCE.

Spruce is known in the two qualities of Merchantable and Scoots. The Scoots comprise boards which are cross grained, renty or rotten. In surveying the grades are divided into two qualities, viz.: Floor Boards and Coarse. The floor boards must be nearly free from knots; all others are coarse.

BURLINGTON, VT., INSPECTION.

Although doing a large business in lumber the extensive market of Burlington has no systematized method of inspection. Steps are, however, in progress looking to that end, and probably before long rules and regulations regarding inspection will be adopted by the dealers in that section. While each lumberman now has an inspection of his own, a variety of customs prevail, notwithstanding an endeavor on the part of all toward uniformity.

The grades recognized in the Burlington market are as follows: Selects, Shelving, Second Shelving, Pickings, Shippers, Box and Mill Culls.

These gradings apply to wide lumber from eight inches and upward.

Strips twelve feet long and upward are classed as First Quality, Second Quality, Third Quality and Box.

Under twelve feet in length the classes of First and Seconds are combined as one, while all unfit for this grade go into a still lower grade of Third Quality or into a new grade of Box.

Spruce is divided into three grades, namely: Clear, number One and number Two. (See Maine Survey.)

Selects.—Comprise the finer grades of lumber, and include all fair widths approaching to the upper grades of other markets, and suited to all the finer finishing purposes, for which the timber is adapted.

Shelving.—Includes ten, twelve and fourteen inch stock, and is classed as First and Second Shelving, as to relative quality and adaptability to

the purpose indicated; First Quality ranks about $7 per thousand below uppers, while the Second Quality is from $5 to $7 below the First. In both qualities more or less knots and sap may be allowed, not affecting the board for the purpose from which it derives its name.

Pickings.—A grade of lumber of any width, suited to one side finishing, embracing sap boards, and generally such lumber as while from width not fitted for shelving, is more defective than Selects, yet filling a position which must otherwise be occupied by Selects. As in other markets, it may be called the cream of the Common. It is relatively in price about $12 below Selects.

Shippers.—Are of diversified widths, without shake or case knots, and free from large, coarse knots, comprising the best of the common after the Picks are removed.

Box.—Comprises a grade poorer than Shippers, yet taking the run of the common, in all fairly sound and merchantable lumber. In price it is from $2 to $3 below Shippers.

The grades of Shelving (First and Second), Pickings, Shippers and Box are, one and all, selections from Common, made with reference to adaptability to the uses indicated by their designations.

Mill Culls.—Are the poorest grade of lumber adapted to any utility, or recognized as merchantable, and bear the same description as the same grade in other markets.

NEW ORLEANS INSPECTION.

TIMBER.

Round.—Length of all logs measured to square butt of log, if with pins at ends, length measured inside of one of the pins, allowing the other. Proportional deductions made from length for extra pins or faults.

Octagon Logs.—Or logs having more than four faces, shall be measured at small end, string measure, girting the log, and one-quarter the girt shall be considered as the fourth of the square. Waney logs, however, not to be comprised amongst the above, but to be measured as explained hereafter.

If crooked, the lines shall be drawn to make the same the chord of the arc of each crook or bend, thus shaping it a perfect squared log from extreme points.

Cypress Timber.—In round logs, when pecky, ten feet off length of logs shall be allowed and deducted as compensation for said fault.

Poplar and Cottonwood.—In round logs to be received at inspection

must measure twenty-four inches in diameter, inside bark, by twelve feet long.

Black Walnut.—In round logs, none shall be received as merchantable measuring less than twenty-six inches in diameter, inside bark, and ten feet long, unless by special agreement.

Squared or Waney.—All logs to be measured gross and net. Gross measurement taken at largest end, or stump, for the square, and at the extreme length of log or spur if any in same. Net measurement taken mid-ways of the log, deducting for net on square logs one inch off two sides of logs, and if waney an additional reduction proportional to wane. In domestic timber with pins or pin-holes, the length for net measurement must be taken inside pins or pin-holes.

Logs of lengths under regulations to be called log ends, and shall be paid on their net measurement one-half price paid for logs of standard dimension.

Sawed or hewed timber shall be put up in three classes, viz: Choice, Prime and Merchantable.

Choice.—To be sound, square edged and square butted; must not show more than two inches of sap on either face, free from circular shakes or unsound knots.

Prime.—To be sound and square butted, to show heart on each face, may show place of wane not to exceed two feet at any one place, and that not more than three places in any one corner.

Merchantable.—To be sound and square butted, not more than three inches in width of wane on a corner; need not show heart on any side.

SPARS.

Mast Sticks.—Must be worked eight square, and must be straight, well hewed, and show heart every four feet in length on every face; free from coarse or unsound knots and other defects; knots over two inches in diameter are called coarse; ring knots and knots less than three feet apart condemned. Not more than four knots must be left in one spar, and must be worked with as little taper as possible.

LENGTH.	DIAMETER AT CENTER.	DIAMETER AT TOP.
66 feet.	Not less than 21 inches.	Not less than 17 inches.
69 "	" " " 23 "	" " " 18 "
76 "	" " " 26 "	" " " 19 "
79 "	" " " 27 "	" " " 20 "
82 "	" " " 28 "	" " " 21 "

Ordinary spars may be hewed four square, though eight square is preferred, may show wane on four corners full length, not over three inches wide in widest place; must show heart full length on four sides, taper as little as possible; must be straight and free from coarse or unsound knots

or other defects. Ring knots and knots less than three feet apart condemned. Not more than four knots must be left in one spar.

LENGTH.	DIAMETER AT CENTER.
66 to 68 feet	17 inches and upward.
69 to 72 "	18 " "
73 to 76 "	19 " "
77 to 80 "	20 " "
81 to 84 "	21 " "

Octagon spars measured with calliper, and square spars with dip rod (three inch hook). Size and length required to hold full. Fractional parts of an inch or foot not counted.

N. B. All the above correspond also to cypress, with only two exceptions. 1st. That cypress having small hollow knots inside the logs, when manufactured in lumber, such knots are not allowed in classes Choice and Prime, but only in class Merchantable. 2d. That cypress, whether it be timber or lumber, can be received in lengths of twelve feet and upward, unless differently stipulated by contract or agreement.

WHITE OAK AND ASH.

White Oak and Ash shall be No. 1, or choice, No. 2, or Prime, No. 3, or Merchantable.

Choice, or No. 1.—Logs to be from body of tree thirty-five or fifty feet long and upward, eighteen to thirty inches square and upward. To be square butted with saw, straight grained, free from heart or side rot, worm holes, large or unsound knots, splits, checks, shakes, frost or sun cracks; good, sound sap on two corners allowed, not to exceed one inch in each corner for every twelve inches in width. If hewn, free from spalls and ax scores, and not to taper over one and one-half inch for every twenty feet in length, and squared to sharp edge. Pins allowed, if these should be the only defect, provided same be found only at both ends, and one side of logs, and not further than six inches from each end, but none in the middle, nor on two sides of logs.

Prime, or No. 2.—Length to be from twenty-five to fifty feet and upward, and to be sixteen to twenty-five inches square and upward, straight grained. To be square butted with saw, splits or checks to be parallel to two sides of log on one end, and allowed at the other end if parallel to the same side of the opposite end. Sap if sound and good allowed on three corners, not to exceed one inch in each corner for every twelve inches in width. Timber to be free from worm holes, large and unsound knots, wind or other shakes, sun cracks allowed only on one side or face of logs; pins or pin holes allowed if not more than nine inches from each end, and only on one side of logs. Diameter of heart rottenness, if any, not to exceed one-twelfth of diameter of log, and not to exceed one foot for every

twenty feet in length, but no side rottenness allowed. If sawed or hewed, to taper as per Class No. 1, wane not to exceed one and one-half inch to perfect square of logs. If hewed, to be free from ax scores.

Merchantable, or No. 3.—Logs to be twenty to thirty feet and upward in length, and to be nothing under fourteen to twenty inches and upward square; to be square butted with saw, splits or checks allowed as in class No. 2. Sap allowed on four corners not to exceed one inch in each corner for every twelve inches in width. Timber to be free from large or unsound knots and worm holes. Wind or other shakes at one end of log received; sun or frost cracks allowed on two sides of logs, pins and pin holes at end and in middle, if not too numerous and only on one side of logs. Heart rottenness received as per Class No. 2, and a slight side rottenness received if only on one side. If log hewn, ax scores admitted if not too numerous. Wane not to exceed two inches to perfect square of logs. Logs to taper two inches for each twenty feet in length. Any timber not within above classification is called rejected, and cannot be branded as inspected, though by special contract it may be accepted by purchasers.

Classification of Pine, Cypress. Poplar, Cotton and other soft woods. All kinds of lumber are measured full contents, the question of sap, etc., etc., being always determined by contract and stipulated classification of same.

Flitch.—All kinds of flitch to be measured at small end of pieces, inside sap on one edge, and sap measured on the other edge.

Deals.—Deals shall be put in three classes, viz.: Choice, Prime and Merchantable.

Choice.—Sound, square edged and square butted with saw, all heart with exception of small streaks of sap on one face, comparatively free from knots, and entirely free from shakes and splits, nine inches and upward in width, three inches and upward in thickness, and twelve feet and upward in length.

Prime.—Sound, square edged, and square butted, one heart face, three-fourths heart on the other face, entirely free from shakes, splits, large or unsound knots, nine inches wide and upward, and twelve feet long and upward.

Merchantable.—Sound, square edged and square butted, one heart face, and show heart on the other face, free from through shakes, splits and unsound knots, nine inches wide and upward, three inches thick and upward, and twelve feet long and upward.

Scantling.—Scantling shall be put in two classes, viz.: Prime and Merchantable.

Prime.—Must be square edged, three corners heart, sound, evenly sawed, free from large or unsound knots, through shakes or splits, twelve

feet long and upward, sizes 2x3 to 11x11 inclusive. Sizes from 8x8 to 11x11 inclusive may show sap on all corners, but not to exceed one to one and one-fourth inch on any one corner, in proportion to the width of the scantling.

Merchantable.—Sound, square edged, evenly sawed, free from through shakes and splits, sizes same as Prime. Four corners sap allowed as in class Prime.

Plank.—Plank shall be put in two classes, viz.: Prime and Merchantable.

Prime.—Must be sound, one heart face, two-thirds heart on the other face, square edged, evenly sawed, free from through shakes or splits, large or unsound knots, one and one-fourth to three inches thick, by ten inches and upward, and twelve feet long and upward.

Merchantable.—Sound, one heart face, evenly sawed, square edged, free from through shakes, splits or unsound knots, one and one-quarter to three inches thick, ten inches wide and upward, twelve feet long and upward.

Flooring.—Flooring shall be put in three classes, viz: Clear, Prime and Merchantable.

Clear.—Must be sound, free from sap, knots, shakes and splits.

Prime.—Must have one face free from sap, and the opposite merchantable.

Merchantable.—Must show one-half heart on most sappy face the whole length, free from through and round shakes or unsound knots.

All flooring must be sawed plump for any size it is calculated for.

Edge boards must be one or one and one-fourth inch thick, any width or length, must be sound, square edged, free from loose knots or splits, and show heart on both sides.

All lumber of a merchantable quality and upward must be square butted. All refuse cullings, or lumber of a quality below these classifications to have no class, but be sold on its merits. Cypress lumber has two special classifications besides those similar to pine, as follows:

Narrow.—To be from four to nine inches in width, three-quarters to one inch thick, and must be sound, square edged and free from sap.

Box Stuff.—To be of any width from two inches and upward, and of one inch full thickness, square edged, and free from sap.

Lumber.—Is to be classed also No. 1, or Choice, No. 2, or Prime, and No. 3, or Merchantable.

Choice, or No 1.—Shall be sound, square edged and butted with saw, and evenly sawed. Widths to be from twenty to thirty inches and upward. Thickness from one-half to eight inches. Length from twenty-five to fifty feet and upward. Entirely free from splits, checks, large and unsound knots, pins or pin holes, frost or sun cracks, worm holes,

wind or other shakes, and with only one-eighth of an inch of sound sap on one corner, for every twenty inches in width.

Prime, or No. 2.—Shall be square edged, butted with saw and evenly sawn. Widths from sixteen to twenty inches and upward. Length from twenty to fifty feet and upward; entirely free from shakes, frost and sun cracks, splits, large or unsound knots and worm holes. Only two pins or pin holes accepted at each end at six to nine inches from end, and one inch sound sap on two corners allowed for every sixteen inches in width.

Merchantable, or No. 3.—Shall be square edged, square butted with saw, and evenly sawn. One heart face on one side and must show heart on two-thirds of length of other face; sap, however, must be sound. Free from through shakes or through splits, and entirely free from large or unsound knots. Pins or pin holes as per Class No. 2. Sun and frost cracks allowed on sappy face only, and not to go beyond two inches in depth on any one face. Lengths from sixteen to twenty feet or more.

Flitch.—Same classifications but dimensions to be taken as stated under the head of Classification.

BLACK WALNUT, CHERRY AND OTHER DOMESTIC HARDWOODS.

Timber.—Shall be put in four classes, viz: No. 1, or Choice; No. 2, or Prime; No. 3, or Merchantable, and Refuse.

Choice, or No. 1.—Logs to be from body of tree, straight grained, and from twelve feet and upward in length, and from twenty-eight inches and upward square; to taper only three-quarters to one inch for every twelve feet in length. To be square butted with saw, free from all defects to make it suitable to best kind of work. Wane allowed one and one-half inch to full square of log for every ten inches width or depth. Pins allowed, if this be the only defect, provided the same be found only at both ends, and on one side of logs, and not farther than six inches from each end.

Prime, or No. 2.—Logs from body of tree, and in length same as No. 1, and with same taper, and from twenty-two inches and upward square. To be straight grained, square butted with saw, free from shakes, bad or large knots, heart or side rottenness, one and one-half inch for every ten inches in width or depth allowed for wane and corresponding sap to same, also pins at both ends of logs, but not further than six inches from each end, and shall be free from splits not parallel to one face.

Merchantable, or No. 3.—Logs in length of ten feet and upward, and eighteen inches square and upward. Taper and wane allowed as in class number Two; free from bad shakes, large or unsound knots, and bad splits; pins allowed as in class No. 2, also splits at the ends of logs though not parallel to sides.

Refuse.—All timber losing one-third or more of its measurement as

allowance for defects shall be called Refuse, and will be considered unfit for shipment unless differently stipulated in contracts of sale.

Lumber.—Shall be divided in three classes, viz: No. 1, No. 2 and Refuse.

No. 1.—Includes all boards, planks and joist free from rot, shakes, and nearly free from knots, sap and bad taper. All pieces to be evenly sawed, square butted, and square edged. Knots to be small and sound, and so few as not to cause waste to the best kind of work. A small split on one end of a board or plank if not too long and parallel with edge of piece, is also classed No. 1.

No. 2.—All pieces must be square edged and evenly sawed; this class includes all other descriptions if so manufactured, except when one-third is worthless, that is, boards, joist or planks containing sap, knots, splits on one end, and all these imperfections combined make less than one-third of a piece unfit for good work, and only fit for ordinary purposes, such piece is classed No. 2.

Refuse.—Includes all boards, planks or joists badly manufactured by being sawed in a diamond shape, smaller in one part than in another, splits on both ends, or with long split or splits not parallel to edge, with large and bad knots, worm or pin holes, sap, rot, shakes, or other imperfections which would cause any one piece of lumber to be one-third worthless or waste.

MAHOGANY, SPANISH CEDAR, AND OTHER LIKE FOREIGN HARDWOODS.

Timber.—Shall be put in four classes, viz.: Choice, Prime, Merchantabe and Refuse.

Choice Cedar.—Must be straight grained, free from knots and all and every other defect. Shall be manufactured straight and evenly, may be hewed or sawed and ought to be square butted with saw before shipment, as all slant heads will be deducted from gross to sale measurement, full up to perfect square of logs, which must measure from twelve feet and upward long, and eighteen inches and upward square. Wane of three-fourths of one inch to perfect square is permitted, but is invariably deducted in its proportional ratio to the log from gross to sale measurement.

Choice Mahogany.—Will correspond to above specifications, except that logs may be curly or cross-grained, and sizes must be twelve feet long and upward, and twenty inches and upward square.

Prime Cedar.—Must be straight grained and free from large knots, small ones, if sound, being allowed. Shall be manufactured as in class Choice. Wormy sap not objectionable if worm-holes do not go through to the body of the wood, and a wane of two inches to perfect square of logs is permitted, also, rotten or decayed heart not to exceed one-eighth of

length of log; splits not to be over six inches for every ten feet of length of log, and sun checks not to be over two inches deep in any one face are also permitted, and though all these defects are permitted, they are invariably deducted from gross to the net, or sale measurement. Logs must be ten feet and upward long, and sixteen inches and upward square.

Prime Mahogany.—Shall correspond to all the above specifications except the logs may be cross-grained, curly and have large knots, if sound, and that sizes must be ten feet long and upward, and eighteen inches and upward square.

Merchantable Cedar.—Logs may be manufactured somewhat uneven, but ought to be square butted with saw, as explained in class Choice. Can be crooked, waney, sappy, wormy, split, sun checked, and have rotten heads and knots, large or small, provided the logs shall not lose more than one-third from the gross to the net sale measurement for these defects. Logs can be from nine feet long and upward, and fourteen inches square and upward. Wood may be curly or cross-grained.

Merchantable Mahogany.—Shall correspond to all the above specifications.

Refuse Cedar and Mahogany.—All other descriptions of wood admitted in this class which by its defects will lose more than one-third from the gross to the net sale measurement, provided logs shall measure nine feet long and upward, and twelve inches square and upward.

Lumber.—Shall be put in three classes, viz.: Choice, Prime and Merchantable.

Choice.—Includes all boards, planks and joists to be square edged, evenly sawed and free from sap, rot, shakes or splits, knots, if any, to be small and sound, and free from any fault which may cause waste for the best kind of work.

Boards and planks to be not less than eighteen inches wide and upward.

Prime.—To be manufactured as class Choice; splits parallel to edge of piece allowed if not exceeding six inches long for every ten feet in length of piece. A streak of sap on two corners allowed, and pieces not to be less than fifteen inches and upward wide.

Merchantable.—Includes all other descriptions of boards, planks and joists, provided all imperfections combined shall not make one-third of the measurement of any piece, any such being rejected and not entitled to classification.

CIGAR CEDAR STUFF.

Cigar Cedar Stuff shall be put in two classes, viz.: No. 1 and No. 2.

No. 1.—All boards to be perfect, free of knots, splits, sap, worm holes, and any defect which would render any piece unfit for the best work.

No. 2.—Includes all other descriptions, except when one-third worth-

less, in which case any such piece is rejected, purchasers having the right to refuse them altogether.

All lumber, such as planks, boards, scantlings, joists, and deals, shall have their contents marked on each piece, and the certificate given by the inspector will state all items of specifications corresponding to the survey made, and also the number of pieces of each class.

For round timber the certificate of the inspector will only give the net contents of each log, and for square timber the logs shall be numbered, and the certificate of measurement must correspond to each number, giving both the gross and the net measure of each, and the faults found when surveying them.

In all circumstances domestic timber of all descriptions, when rafted, will class Choice, if with no other fault in same but wooden pins needed for its safety in rafting it, provided, however, that same be placed only at both ends of logs not further than nine inches from each end, and none in the middle.

STAVES.

No. 1, pipe	60	in. long,	5	to 6	in. wide,	1½	in. thick on thin edge.
No. 2, pipe	56	"	5	" 6	"	1½	" "
No. 3, pipe	56	"	4	" 5	"	1	" "
No. 1, hogshead	48	"	5	" 6	"	1½	" "
No. 2, hogshead	44	"	5	" 6	"	1½	" "
Claret staves	40	"	5	" 6	"	1½	" "
Barrel staves	33	"	5	" 6	"	1½	" "

All of the above staves must be made of white oak, over cup or cow oak, and riven with the grain to as equal thickness as possible. If in riving, a stave is thicker on the back, the surplus timber should be taken off, thus making both edges about even in thickness. An allowance of two inches should be made for crooked sawing, otherwise many staves will be under the required length. Staves must be clear of sap, heart, knots, short crooks, wind shakes and worm-holes. The proper manner of sapping is to strike the stave at the end, leaving a slight bulge in the center. The timber must be cut when the sap is down, that is during the fall and winter. When a stave is spoiled by any of the defects above named, it should be sawed down to the length of a shorter dimension, as many defective sixty inch staves by sawing would make good forty-four, forty or thirty-three inch staves. Staves are sold by the thousand of 1,200 pieces.

Hoop poles should be of smooth barked hickory, free from heavy butts and switch tops. Hogshead poles twelve to fourteen feet in length and one full inch in diameter at the top. Barrel poles eight feet in length and full three-fourths of an inch at the top. Half barrel poles seven feet long, one-half inch at top.

BOSTON INSPECTION.

The Inspection of Boston is under the state law. This law provides for a surveyor general, appointed every three years by the governor, who in turn appoints a sufficient number of deputy surveyors, removable at his pleasure, and for whom he shall be responsible. These officers are under bonds for the faithful discharge of their duties, and a record is kept and returned annually to the secretary of the commonwealth, specifying the amount, and various kinds and qualities of lumber surveyed during the year. While the law provides for the following classification, it is nevertheless optional with the buyer or seller as to its use. In pine lumber, especially, except in the lower grades shipped from the East, this inspection is almost obsolete. Western grading is recognized, and Uppers, Selects and Fine Common are bought and sold as such, without reference to Boston Survey.

The law provides for the following classification:

PINE BOARDS AND PLANK.

Of pine boards and planks, except southern pine, there shall be six sorts. The first shall be denominated No. 1, and include boards not less than one inch thick, square edged, free from rot, shakes, and nearly free from knots and sap, except such boards and planks as are not more than one-eighth waste, which shall be received as No. 1. The second sort shall be denominated No. 2, and include boards not less than one inch thick, and of which not less than seven-eighths is suitable for planing and first class finish: *provided*, that such boards as are clear but deficient in thickness as aforesaid, shall be received as No. 2. The third sort shall be denominated No. 3, and include boards not less than seven-eighths of an inch thick, and of which not less than three-fourths is suitable for planing and second-class finish. The fourth sort shall be denominated No. 4, and include boards not less than seven-eighths of an inch thick, nearly free from rot, and nearly square edged, free from loose and large branch knots, and suitable for covering buildings; all Norway pine boards and planks shall be included in the fourth, fifth and sixth sorts. The fifth sort shall be denominated No. 5. and include all boards and planks of every description not being within the other four denominations, except when one-third is worthless, which boards and planks shall be denominated refuse.

DIMENSION.

Of pine joists and dimension timber there shall be three sorts. The first sort shall be denominated No. 1, and include all joists and dimension timber that are sound and nearly square edged. The second sort shall be denominated No. 2, and include all other description, except when one-third is worthless, which joists and dimension timber shall be denominated Refuse.

SPRUCE, ETC.

Of spruce, hemlock, juniper, and southern pine, boards, planks, sawed timber and joists, there shall be three sorts. The first shall be denominated No. 1, and include all boards, planks, sawed timber, and joists, that are sound and nearly square edged. The second sort shall be denominated No. 2, and include all other descriptions. except when one-third worthless, which boards, planks, sawed timber, and joists, shall be denominated Refuse.

HARDWOOD.

Of ash, maple, and other hardwood and ornamental boards, planks, and joists, there shall be three sorts. The first shall be denominated No. 1, and include all boards, planks and joists that are fee from rot, shakes, and bad knots. The second sort shall be denominated No. 2, and include all other descriptions, except when one-third is worthless, which boards, planks and joists shall be denominated refuse.

HEWED TIMBER.

Of hewed timber, except mahogany and cedar, there shall be three sorts. The first sort shall be denominated No. 1, and include all timber that is sound and nearly square edged. The second sort shall be denominated No. 2, and include timber of all other descriptions, except when one-third is worthless, which timber shall be denominated refuse.

SHIP KNEES.

Of oak, juniper and spruce knees, there shall be two sorts. The first sort shall be denominated No. 1, and include all sound knees of the following dimensions: arm or root one foot six inches long, body of knee three feet long, working thickness four inches; arm or root two feet and six inches long, body of knee three feet long, working thickness five inches; arm or root two feet and nine inches long, body of knee three feet and six inches long, working thickness six inches; arm of root three feet and three inches long, body of knee four feet and six inches long, working thickness seven inches; arm or root three feet and six inches long, body of knee four feet and three inches long, working thickness eight inches; arm or root three feet nine inches long, body of knee four

feet six inches long, working thickness nine inches; arm or root four feet long, body of knee five feet long, working thickness ten inches and upward. The second sort shall be denominated refuse, and shall include all other descriptions of less dimensions than those specified in the first denomination; all knees shall have the working thickness marked thereon, and on the first sort the number "*one*" shall be marked.

QUEBEC CULLING.

Extracts from the Culler's Act, giving Rules for the Measurement of Timber, Masts, Spars, Deals, Staves, Etc., Etc.

All culling in Quebec must be done under the specification of an act of the Provincial Parliament, from which we extract the following salient points:

All square timber must be measured by one of three modes.

First.—Measured off in the raft or otherwise, giving the full cubical contents without allowance or deduction.

Second.—Measured in shipping order (which shall mean sound, fairly made timber); gum seams closed at the butt, and sound knots not be be be considered unsoundness—lengths under the merchantable standard hereinafter mentioned, and not less than twelve feet long to be received if, in the opinion of the Culler, the same be fit for shipment.

Third.—Culled and measured in a merchantable state, in accordance with the rules, standards and limitations hereinafter described. (8 Vic., cap. 49. sec. 9.)

In measuring timber the Culler employed for that purpose shall measure the length of each piece, together with the girth, and shall provide himself with a measuring rod and tape, which shall, in all cases, be English measure, tested and compared with a standard kept in the office of the Supervisor (such rod having a hook at the end five-eighths of an inch long); and also a scribing knife, with which he shall mark in legible characters, the length, breadth and thickness of all square timber measured or culled by him, and the mark, initials or number of the party, if required. And every Culler shall provide himself with a proper stamp, with the initials of his name in legible characters. and with the following capital letters in addition:

M, which shall denote what is merchantable.

U, which shall denote what is sound and of merchantable quality, but under merchantable size.

S, which shall denote what is second quality.

T, shall denote what is third quality.

R, shall denote what is rejected or unmerchantable; which marks shall be indented or stamped on the end of each article of lumber culled, in terms of merchantable standard hereinafter described, except West India and barrel staves, boards, lath wood and handspikes.

In all cases the Supervisor and Cullers shall be governed by the following descriptions, rules, standards and limitations, in ascertaining and certifying the merchantable size and quality of lumber submitted to their culling.

SQUARE WHITE OAK TIMBER.

First Quality.—Shall be free from rot, rotten knots, (affecting the surrounding wood), open rings and large grub or worm-holes; but small worm-holes and shakes shall be allowed, according to the judgment of the Culler.

Second Quality.—Shall be oak not coming within the definition of first quality, and which in the judgment of the Culler is not culls.

SQUARE HARD GRAY OR ROCK ELM.

Shall be free from rots, open rings and rotten knots, (affecting the surrounding wood); but shakes and slivers shall be allowed according to the judgment of the Culler.

WHITE, RED OR YELLOW PINE TIMBER.

Shall be free from rot, rotten knots (affecting the surrounding wood), worm-holes, open shakes and open rings; but sound knots shall be allowed, according to the judgment of the Culler.

SQUARE RED PINE TIMBER.

Shall be free from rots, rotten knots, (affecting the surrounding wood), worm-holes, shakes and splits; but sound knots shall be allowed according to the judgment of the Culler.

SQUARE ASH, BASSWOOD AND BUTTERNUT.

Shall be of the same quality as White or Yellow Pine square timber.

SQUARE BIRCH.

Shall be free from rot, rotten knots, splits and shakes and shall be allowed two inches of wane.

MASTS, BOWSPRITS AND RED PINE SPARS.

Shall be sound, free from bad knots, rents and shakes, and the heartwood shall be visible in spots at or near the partners.

HICKORY HANDSPIKES.

Shall be six feet long, and three and a half inches square at the small end.

ASH OARS.

Shall be three inches square on loin, and five inches broad on the blade. The blade shall be one-third of the length of the oar; and such oars shall be cleft straight on all sides, and free from large knots, splits and shakes.

LATH WOOD.

Shall be cut in lengths of from three to six feet, and measured by the cord of eight feet in length, by four feet in height. To be merchantable shall be free from rot, and split freely; each billet may contain to the extent of three or four open case knots, provided they run in line, or nearly so; and it shall not have more than one twist.

PINE OR FIR BOARDS.

Shall not be less than ten feet in length, nor less than one inch in thickness, nor less than seven inches in breadth, equally broad from end to end, edged with a saw, or neatly trimmed by a straight line, and shall be free from rot, bad knots, rents and shakes, and of equal thickness on both edges from end to end; but the color alone of any board shall not be sufficient cause for its rejection, if it is in other respects sound and merchantable. and of the dimensions required by this Act.

WHITE OR YELLOW PINE DEALS.

First Quality.—To be merchantable. Shall be free from rot, rotten knots, grub worm-holes, open case knots, shakes and splits (a slight sun crack excepted); and sound knots and hard black knots to be allowed as follows: If not exceeding three in number, and not exceeding upon the average one inch and a quarter in diameter; if exceeding three and not exceeding six in number, and upon an average not exceeding three-quarters of an inch in diameter; this proportion of knots to be allowed for a deal eleven inches in width and twelve feet in length; and deals of greater or less dimensions to be allowed for in proportion, according to the judgment of the Culler. Wane equal to half an inch on one side if running the whole length of the deal to be allowed; and if not exceeding half the length of each deal, three-quarters of an inch to be allowed; they shall be free from black or dead sap (with a slight exception), at the discretion of the Culler.

WHITE OR YELLOW PINE SECOND QUALITY DEALS.

Second Quality.—Shall be free from rot, rotten knots and splits, with

slight exceptions at the discretion of the Culler; and sound knots and hard black knots to be allowed as follows: If not exceeding six in number, and not exceeding upon the average one inch and a half in diameter; if exceeding six, and not exceeding twelve in number, and not exceeding upon the average one inch and one-quarter in diameter (small knots under half an inch in diameter not to be counted or considered), this proportion of knots to be allowed for a deal eleven inches wide and twelve feet in length, and deals of greater or less dimensions to be allowed for in proportion, according to the judgment of the Culler; heart, shakes and sun cracks not exceeding three-fourths of an inch in depth to be allowed, as also worm-holes, at the judgment of the Culler; wane of half an inch to one inch to be allowed, according to the quality of the deal; in other respects at the judgment of the Culler. Deals rejected as not coming within the standard of merchantable, or second quality, shall be classed as culls, except that the Culler may, if requested by buyer and seller, select and classify as Third Quality the best of the deals so rejected.

RED PINE DEALS.

To be merchantable shall be free from rot, rotten knots, grub wormholes, open case knots and splits; several small sound knots to be allowed, according to the judgment of the Culler; heart shake to be allowed, if it does not run far into the deal, or form a split through at the ends; they shall be free (or nearly so) from black or dead sap; but sound sap in the corners or on a portion of one face of a deal to be allowed, according to the judgment of the Culler.

SPRUCE DEALS.

To be merchantable shall be free from rot, rotten knots, grub wormholes, open case knots, splits and shakes (a heart shake, not exceeding one-fourth of an inch in depth, excepted); several small sound knots and hard black knots to be allowed, according to the judgment of the Culler, and in the exercise of such judgment, he shall keep in view the peculiar nature of the wood, and govern his judgment accordingly; wane equal to half an inch on one edge, if running the whole length of the deal, to be allowed; and if not exceeding one-quarter the length of such deal, three-quarters of an inch to be allowed.

SPRUCE AND RED PINE DEALS.

Second Quality.—Shall be deals not coming within the definition of merchantable, and which, in the opinion and judgment of the Culler, are not culls, and shall be classed as second quality; and the Culler, if required by seller and buyer, may select and classify as THIRD QUALITY the best of the deals unfit to be Seconds.

QUEBEC STANDARD HUNDRED OF DEALS.

Shall be one hundred pieces, twelve feet long, eleven inches wide, and two and one-half inches thick; and deals of all other dimensions shall be computed according to said standard. Deals of all qualities shall not be less than eight feet long, seven inches broad and two and a half inches thick.

Deal ends shall not be less than six feet long; lengths should never fall short of full feet, or be more than two inches over length, and shall be computed according to the Quebec standard.

MERCHANTABLE DEALS.

Must be well sawed (this point must have especial attention), and squared at the end with a saw; and the color alone shall be no objection to their being merchantable. All deals when culled shall in all cases be stamped with the initials of the Culler, and the capital letter denoting their quality as such.

PROVISO AS TO SPRUCE DEALS.

Provided always that spruce deals, if not sawed at ends prior to or at the time of culling, shall be marked with the capital letter denoting their respective qualities, with red chalk, in large, bold letters.

HOW OTHER DEALS SHALL BE MADE.

To prevent mistakes in piling, all other deals shall be marked with bold strokes, in red chalk, as follows:

Merchantable shall be marked I.

Second quality shall be marked II.

Third quality (if made) shall be marked III.

Rejected, or culls, shall be marked X.

DIMENSION OF STAVES.

Standard or measurement staves shall be of the dimensions set forth in the words and figures following:

5½	feet	long,	5	inches	road,	and	from	1	to 3	inches thick.
4½	"	"	4½	"	"	"		1	to 3	" "
3½	"	"	4	"	"	"		1	to 3	" "
2½	"	"	5	"	"	"		1	to 3	" "

HEART STAVES.

Five and a half feet long, and four and a half inches broad, to be received as if of merchantable dimensions.

STANDARD MILLE.

Shall be twelve hundred pieces of five and a half feet long, five inches

broad, and one and a half inches thick; and standard or measurement staves of other dimensions shall be reduced to the said standard by the tables of calculation in use.

WEST INDIA OR PUNCHEON STAVES.

Shall be three and a half feet long, four inches broad and three-fourths of an inch thick; all staves shall be straight-grained timber, properly split, with straight edges, free from grub or large worm holes, knots, veins, shakes and splinters; and small worm holes, not exceeding three in number, to be allowed, according to the judgment of the Culler, provided there are no veins running from or connected therewith; and the Culler shall measure the length, breadth and thickness of standard staves, at the shortest, narrowest and thinnest parts; and the thickness of West India and barrel staves exceeding the standard breadth to be measured at such breadth, to wit: four, and three and a half inches, respectively, provided the thinnest edge is not less than half an inch.

TIMBER.

The dimensions of merchantable timber shall be as set forth in the following words and figures:

OAK TIMBER.

Shall not be less than twenty feet in length, nor less than ten inches square in the middle.

ELM.

Shall not be less than twenty feet in length, or less than ten inches square in the middle.

WHITE PINE.

Shall not be less than twenty feet in length, and twelve inches square in the middle, and fifteen feet and upward in length, if sixteen inches and and upward in the middle.

RED PINE.

Shall not be less than twenty-five feet in length, and ten inches square in the middle, and twenty feet and upward in length, if twelve inches square and upward in the middle.

BIRCH.

Shall not be less than six feet long, or less than twelve inches square in the middle.

TAPER OF MERCHANTABLE TIMBER.

Oak, three inches under thirty feet, and in proportion for any greater length; elm, two inches; white pine, one and a half inches; red pine, two

inches; ash, one and a half inches; basswood, one and a half inches; butternut, one and a half inches. Bends or twists not to exceed one in number.

HOLLOWS ALLOWED.

Oak, three inches for every twenty feet in length, and in proportion for any greater length; elm, three inches; white pine, two and a half inches; red pine, three inches; ash, two and a half inches; basswood, two and a half inches; butternut, two and a half inches.

DIMENSIONS OF WHITE PINE MASTS, BOWSPRITS AND RED PINE SPARS.

White Pine Masts, twenty-three inches and upward at partners, shall be three feet in length to each inch in diameter; twenty-two inches, three feet, and three feet extreme length; twenty-one inches and under, three feet, and three feet extreme length; twenty inches and under, three feet, and four feet extreme length. Hollow or bend not to exceed six inches for seventy feet, and in proportion for any greater length.

BOW SPRITS.

Shall be two feet in length for every inch in diameter at the partners, adding two feet for extreme length.

RED PINE SPARS.

Shall be three feet to the inch in diameter at the partners, and nine feet extreme length; hollow not to exceed seven inches for sixty feet, and in proportion for any greater length.

RE-DRESSING.

In all cases where it appears that timber, masts, spars, boards, planks, deals, staves, oars or any other description of lumber, are not properly hewed, squared, butted or edged, but are merchantable in other respects, and sold as such, the Supervisor and Culler, respectively, shall order or cause the same to be properly dressed and chopped, at the expense of the buyer or seller, as the case may be, previously to their being respectively received and certified to be merchantable, such dressing and chopping to be done under the direction of the Culler in charge of the measuring or culling.

MINNEAPOLIS INSPECTION.

At a meeting of the Lumberman's Board of Trade, held May 25, 1878, the plan for securing uniformity in the sorting of lumber was fully inaugurated, and the grades as nearly determined upon as it is possible to define them by any set of words. Entire harmony of opinion exists among the manufacturers of the city as to the uselessness of some of the grades or kinds which have been put upon the market, and it was unanimously resolved to decrease the number of kinds by striking out several. The committee appointed for the purpose, after fully considering the matter, reported the following list and description of grades:

First Clear.—Shall be not less than twelve inches wide and twelve feet long; shall be free from all imperfections, with no sap, except where over fourteen inches wide; then allow not over one inch on one side.

Second Clear.—Shall be not less than ten inches wide and twelve feet long; defects may be allowed, not to exceed two knots of three-fourths of an inch in diameter, or sap that will be equal to one inch on one side. If the width be sixteen inches or upwards, defects may be allowed equal to three knots of one inch in diameter, or sap equal to three inches the whole length.

Third Clear.—Shall be not less than seven inches wide and twelve feet long; defects, equal to three knots one inch in diameter and sap one and one-half inch wide in boards to twelve inches; and from twelve to sixteen inches wide, knots of two inches in diameter and sap two inches on one side; on boards over sixteen inches, defects may be increased to knots equal to four inches, and to four inches of sap.

Clear Strips.—Shall be six inches wide and full one inch thick; will allow one inch of sap, but no other imperfections.

First Flooring.—May be four, five or six inches wide; allow one inch of sap and three small sound knots, but no other imperfections. These imperfections to apply to six inch flooring and to decrease according to width.

Second Flooring.—Same as first, in width; allow six small knots, and sap equal to one and one-half inch the whole length.

Common Flooring.—Shall be four, five and six inches wide; allow defects equal to eight small knots; sap or shake and split not to exceed two feet in length.

First Siding, Dressed.—Allow one inch sap on thin edge, but no other imperfections.

Second Siding, Dressed.—Allow one inch sap on either edge, and three small knots, but no other imperfections.

Common Siding, Dressed.—Allow sap and defects equal to eight small knots, and shake or split two feet in length.

A Stock.—May be eight to twelve inches wide, twelve to sixteen feet long, and of a quality equal to Third Clear Boards.

B Stock.—Shall be eight, ten and twelve inches wide; shall be sound and square edged; allow from four to eight small, sound knots, or sap not to exceed four inches in width the whole length of the best side.

C Stock.—Shall be eight, ten and twelve inches wide; shall be sound and square edged. Will allow from eight to twelve sound knots, according to width, and will allow Norway.

D Stock.—Shall be eight, ten and twelve inches wide, and of like quality with common boards.

First Fencing.—Shall be four, five and six inches in width; shall be of good, sound character, free from imperfections that so weaken a piece that it cannot be used for substantial fencing purposes.

Second Fencing.—Defective and unsound lumber.

Common Boards.—Shall be seven inches wide and upward, and eight feet long; of good, sound lumber and free from large, loose knots, and well manufactured: will allow a little wane or a straight split, when otherwise sound and good.

Common Dimension and Timber.—Shall be of sound lumber and well manufactured; shall have no imperfections that will render it unfit for substantial building purposes. Some wane allowed.

Sheathing Boards.—Shall be boards that are unsound in quality, with loose knots, shakes, splits and worm eaten, but of sufficient good quality to make good roofing boards, and to be six inches wide and upwards.

A few yards make a grade called E Stock, in which case the D and C Stocks are made a little better than these rules call for.

LOG MEASUREMENTS.

In presenting for the acceptance of log buyers a new table of log measurements, the author is aware that he has the prejudices of half a century to combat, during which time the Scribner and Doyle rules have been of almost universal acceptance. Were the tables of those authors susceptible of full authentication, the task would prove a hopeless one, for the reason that correct figures never mislead, but endure in their integrity through all time. When, however, the task was commenced of giving to the lumber trade a reliable compendium of the laws and customs governing the inspection of lumber in various localities, the compiler appreciated the importance of beginning at the inception of the business, and supplying the log dealer with the most reliable rules of measurement, through a recommendation to him to adopt one or the other of the standards already in use. Aware that in some localities Scribner's rule was the favorite, while Doyle's was denounced as incorrect, and in others, Scribner's was denounced and Doyle's commended, the author was led to make careful examination of both, with a view to a thorough analysis of each in this work.

On taking up the latest edition of the work entitled: "Scribner's Log and Lumber Book," (1879) it was a matter of surprise to find that the publishers in announcing, under date of 1872, the ownership of the Doyle stereotype plates, as well as those of Scribner, at the same time announced the discontinuance of the publication of the Doyle and the permanent adoption of Scribner's tables. In connection with the log tables appears an announcement that from the many complaints which had been made of the incorrectness of the Scribner tables, they had been discarded and the Doyle tables substituted.

An examination of the Doyle tables shows that so far from being made from the actual cutting up of logs, or even from a carefully prepared diagram, which should give equally correct results, a novel and arbitrary rule of reckoning had been adopted, and that on logs of all sizes, a deduction of four inches from the diameter, the remainder being then multiplied by itself, in all cases gave the number of feet in a log sixteen feet in length. For example, a log twelve inches in diameter and sixteen feet long: 12—4=8×8=64 feet. Deducting one-eighth, or eight feet, gives fifty-six feet as the contents of the same log at fourteen feet long, and the addition of one-eighth gives seventy-two feet as the contents of the same

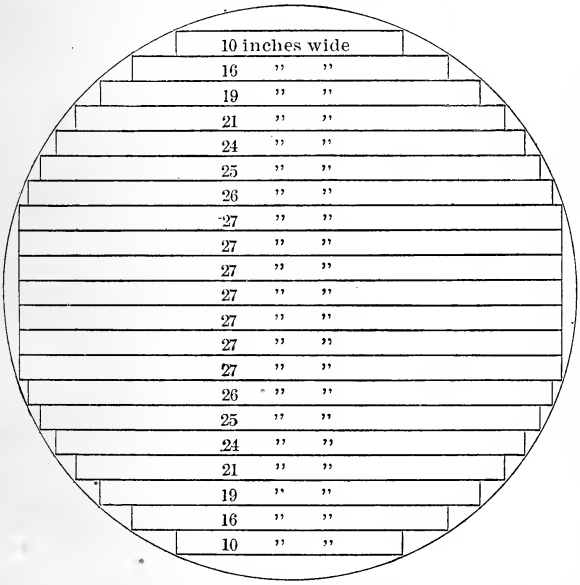
sized log at eighteen feet in length. It will not be denied by any thinking mind that if a deduction of four inches is correct for a log of twelve inches diameter, the same amount of deduction would be utterly disproportionate in a log of forty-eight inches. If, however, the practical cutting up verified the correctness of the figures, then indeed might one be warranted in asserting that a universally correct method of arriving at the contents of saw logs has been practically demonstrated.

That such is not the case the following carefully prepared table must convince the most incredulous. By means of a carefully prepared diagram of each size of logs from eight up to forty-eight inches, and from ten feet in length up to thirty feet, embracing all the lengths and diameters which are likely to enter into practical use, and after allowing a slab of one inch upon each side of the log, the following table has been prepared of the contents of each saw log of the sizes given, when cut into boards of one and one-sixteenth inch thickness, by a saw taking one quarter inch kerf, every board being square edged, and no lumber measured under five inches in width.

Any reliable man familiar with the cutting up of saw logs is hereby challenged to disprove the assertion that a straight log of any given dimension, sawed as above stated, will yield the amount of lumber shown in the tables. Of course no allowance is made for the crooked or otherwise defective logs, for this would be encroaching upon the domain of the inspector, who is supposed to make the crooked straight in taking his diameters, and to allow for all other defects, such as rotten butts, at the same time. No good sawyer will criticise the allowance of one-quarter of an inch for saw kerf; it is enough, and the sawyer who cannot file and set his circular, mulay or gate saw to do good work at that amount of waste, is an unfit man for his position, while in gang mills, one-eighth of an inch is about the usual waste in kerf. In allowing one-sixteenth of an inch for plump lumber, an old and well established rule that all lumber should be cut to season to its intended thickness is adhered to. The tables are presented for the approval of those dealing in saw logs, with the assurance that in their preparation the interest of neither buyer nor seller, as such, has been considered, the only object being to produce a table which would represent the actual quantity of lumber which a log will produce under the manipulation of an ordinarily competent sawyer. To enable comparisons between this and the other rules mentioned, a synopsis of the corresponding sizes and lengths of both the Doyle and Scribner tables will be found upon succeeding pages.

The following diagram will show at a glance the manner in which the author has worked out each individual log. It is drawn on a scale of one-tenth of an inch to the foot, and shows the number of one and one-sixteenth inch boards which can be taken from a log of thirty inches

diameter, twelve feet in length, by the Lumberman's "Favorite" scale, which, since this book was first published, in 1877, has been quite generally adopted by lumber and log men as the most equitable standard known. The actual cutting of the log into twenty-one boards, requiring twenty saw kerfs of one-fourth inch each, twenty lines of one-sixteenth excess, and two slabs of one inch each, equalling a deduction in the aggre-



gate of eight and one-quarter inches from thirty inches, the diameter of the log, gives twenty-one and three-fourths inches, which, multiplied by itself, leaves a net result of 476 feet, against 474 feet, obtained in the cutting up in the manner shown — the loss of fractional parts of an inch accounting for the difference of the two feet. This fact effectually disproves the correctness of the Doyle rule, which gives the same log a measurement of 507 feet. Hickory rules for measuring logs after this scale may be obtained from the publishers of this book.

THE LUMBERMAN'S FAVORITE LOG RULE.

Entered according to Act of Congress in the year A. D. 1880, by W. B. JUDSON, in the office of the Librarian of Congress, at Washington, D. C.

DIAMETER OF LOG, INCHES.

LENGTH OF LOG, FEET.

Feet	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	Feet
8	4	12	19	33	50	72	99	124	162	196	240	282	316	367	422	465	518	580	638	701	778	848	8
10	5	15	24	41	62	90	124	155	203	245	299	352	395	454	529	575	649	725	792	877	967	1060	10
12	6	17	28	49	74	107	148	186	243	294	358	422	474	544	634	690	778	870	950	1052	1160	1272	12
14	7	19	32	57	86	124	172	218	283	343	417	492	553	634	739	805	907	1015	1108	1227	1353	1484	14
16	8	22	37	64	98	142	197	248	324	392	476	562	632	725	845	920	1037	1160	1266	1402	1546	1696	16
18	10	25	42	73	111	160	222	279	364	441	537	633	711	816	951	1035	1167	1305	1425	1578	1740	1908	18
20	12	28	46	81	122	177	246	308	405	490	596	703	790	908	1058	1150	1298	1450	1584	1754	1934	2124	20
22	14	32	48	89	134	192	268	340	446	539	656	773	869	998	1163	1265	1427	1595	1742	1929	2125	2332	22
24	16	34	56	98	148	214	296	372	486	588	716	844	948	1088	1268	1380	1556	1740	1900	2104	2320	2544	24
26	18	36	60	106	160	231	320	404	526	637	775	914	1027	1178	1373	1495	1685	1885	2058				26
28	20	38	64	114	172	248	344	436	566	686	834	984	1106	1268	1478	1610	1814	2030	2216				28
30	22	41	68	120	184	266	368	462	609	735	893	1054	1185	1362	1587	1725	1947	2175					30

LENGTH OF LOG, FEET.

SYNOPSIS OF SCRIBNER'S LOG RULE.

DIAMETER OF LOG IN INCHES.

LENGTH FT.	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	LENGTH FT.
12	59	73	86	107	119	139	160	180	210	228	251	283	303	344	375	411	12
14	69	85	100	125	139	162	187	210	245	266	292	330	353	401	439	479	14
16	79	97	114	142	159	185	213	240	280	304	334	377	404	459	500	548	16
18	88	109	129	160	178	208	240	270	315	342	376	424	454	516	562	616	18
20	98	122	143	178	198	232	267	300	350	380	418	470	505	573	625	684	20
22	108	134	157	196	218	255	293	330	385	418	460	518	555	631	688	753	22
24	118	146	172	214	238	278	320	360	420	456	501	566	606	688	750	821	24

DIAMETER OF LOG IN INCHES.

LENGTH FT.	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	LENGTH FT.
12	436	457	493	532	552	588	600	657	692	772	801	840	903	954	1007	1046	1110	12
14	509	533	575	622	644	686	700	766	807	901	934	980	1053	1113	1175	1222	1295	14
16	582	609	657	710	736	784	800	876	923	1029	1068	1120	1204	1272	1343	1396	1480	16
18	654	685	739	799	828	882	900	985	1038	1158	1201	1260	1354	1431	1511	1571	1665	18
20	728	761	821	888	920	980	1000	1095	1152	1287	1335	1400	1505	1590	1679	1745	1850	20
22	800	838	904	976	1012	1078	1100	1204	1268									22
24	873	914	986	1065	1104	1176	1200	1314	1380									24

Synopsis of Doyle's Log Rule.

DIAMETER OF

LENGTH IN FEET.	10	11	12	13	14	15	16	17	18
12	27	37	48	61	75	91	108	126	147
14	32	43	56	71	88	106	126	144	171
16	36	49	64	81	100	121	144	169	196
18	41	55	72	91	112	136	162	190	220
20	46	61	80	101	125	151	180	211	244
22	50	67	88	111	137	166	198	232	269
24	54	74	96	122	150	181	216	254	294
26	59	80	104	132	163	196	234	274	318
28	63	86	112	142	175	212	252	296	342
30	68	92	120	152	188	226	270	316	368

DIAMETER OF

LENGTH IN FEET.	29	30	31	32	33	34	35	36	37	38
12	469	507	547	588	631	675	721	768	817	867
14	547	591	638	686	736	787	841	896	953	1011
16	625	676	729	784	842	900	961	1024	1089	1156
18	703	761	820	882	946	1012	1081	1152	1225	1300
20	782	845	912	980	1052	1125	1202	1280	1361	1446
22	860	930	1004	1078	1156	1238	1322	1408		
24	938	1014	1094	1176	1262	1350	1442	1536		
26	1016	1098	1184	1274	1368	1462	1562	1664		
28	1094	1182	1276	1372	1472	1574	1682	1792		
30	1172	1266	1366	1470	1578	1688	1802	1920		

Synopsis of Doyle's Log Rule.

LOG IN INCHES.

19	20	21	22	23	24	25	26	27	28	
169	192	217	243	271	300	331	363	397	432	12
197	224	253	283	313	350	386	433	463	504	14
225	256	289	324	359	400	441	484	530	576	16
253	288	325	364	406	450	496	544	596	648	18
280	320	361	404	452	500	550	605	661	720	20
309	352	397	445	496	550	605	665	726	792	22
338	384	433	486	541	600	662	726	794	864	24
366	416	470	526	586	650	716	786	860	936	26
394	448	506	566	626	700	772	866	926	1008	28
422	480	542	606	672	750	826	906	992	1080	30

LOG IN INCHES.

39	40	41	42	43	44	45	46	47	48	
910	972	1027	1083	1141	1200	1261	1323	1387	1452	12
1070	1134	1198	1264	1331	1400	1471	1544	1618	1694	14
1225	1296	1369	1444	1521	1600	1681	1764	1849	1936	16
1379	1458	1541	1625	1711	1800	1891	1985	2080	2178	18
1530	1620	1712	1805							20
										22
										24
										26
										28
										30

SHINGLE MANUFACTURE.

The manufacture of shingles is practically the same in all sections of the country, and comprises the two classes of breasted, usually spoken of as shaved, and sawed shingles.

Breasted or shaved shingles are, in white pine, usually eighteen inches in length, the standard thickness being five shingles to two and one half inches in thickness at the butt, and one-sixteenth inch at the point. Sometimes, though of late but seldom, they are made a full half inch thick at the butt. In some markets, notably as we go South, we find some white pine shingles twenty-four inches long, with butts of five-eighths and points of one-eighth inch. The cypress and cedar shingles of Virginia and further South are largely of twenty, twenty-four and thirty inches length by one-half inch butt.

A breasted shingle should be of full length with square ends, even thickness of butt, and uniform points, with no clips at the point. The dressing or breasting should be perfectly smooth, as though planed, and free from ridges or grooves. Nothing less than a standard shingle four inches wide should be packed in the bunch, although an occasional three inch is not criticised. The edges should be perfectly square, unless, as practiced by some first-class makers, they are uniformly beveled so that one edge will fit the next with a partial overlay.

Breasted shingles are usually packed in bunches of 500, or two bunches to the thousand, the bunches being packed twenty-four inches wide (six shingles) by forty-two courses at each end. Cypress and other extra length shingles are packed in round bunches of 100 shingles each. Clipped and imperfectly breasted shingles are classed as No. 2, or Common. Shaved shingles of less than seven-sixteenths butt must be uniform and nice to be admitted to the brand of No. 1, or Extra.

Sawed shingles are manufactured at different points, of different sizes. Michigan produces for the eastern and southern trade nothing but eighteen inch shingles, while the Chicago and western trade demands only sixteen inch shingles. Some markets use fourteen inch and even twelve inch lengths.

The best sawed shingles are made from split quartered white pine, although the practice of quartering with a saw is an extended one. In the hands of an inexperienced sawyer a sawed block will often be made to turn out bastard shingles, which are objectionable, and, in fact, worthless

upon a roof. Shingles should always be sawed with, and not across the grain. The inspection of shingles of all lengths is the same. Eighteen inch are always sawed five to two and one-fourth inches at the butt, one-sixteenth points, except on special orders for cuts of five to two inches. Sixteen inch shingles are cut five to two inches at the butt, with one-sixteenth inch points.

There are so many designations given to shingles by various manufacturers, that it would be impolitic to give anything but standard classifications. Strictly first-class shingles are always entitled to a brand of XXX, and in bunches so marked should be found only shingles of full length, full thicknesses and uniform points; free from all rot, shake, sap, knots, worm-holes, bastards or defects of any nature; they should be packed in uniform bunches of 250 shingles, four inches wide always being the standard shingle. All shingles the manufacturers of which have adopted fancy brands, such as "Star," "Extra," etc., should come up to the standard given for XXX.

No shingle should be packed in a bunch of No. 2 shingles which is not free from all defects, sap included, to such extent that the shingle is perfect for at least six inches from the butt, and the defects from that to the point must be of a character which will forbid the passage of water through the shingles. These are by some makers branded "six inch clears," while a brand of "ten inch clear," or twelve inch clear," denotes a shingle free from defects for the length indicated, measuring from the butt. As a rule no shingles can be considered marketable which will not lay five inches to the weather in eighteen inches, and four inches to the weather in sixteen inches, without showing defects at the butt; eighteen inch XXX are usually laid six inches to the weather, and sixteen inch XXX are laid from four and a half to five inches to the weather.

It is not uncommon, however, to pack the coarse shingles in bunches marked No, 2, where the brands of XXX for the best, and X or XX for the clear butts is adopted. In connection with the brand "A" largely in vogue in the West, "choice A" is the equivalent of XXX, and is better than "standard A" only in some minor respects more fictitious than real, for anything which deserves the name standard is supposed in shingles to mean the best, and custom of many years standing has decreed that XXX shall always be a standard or choice shingle.

"Shaded A" may represent a clear butt of six, ten or twelve inches, but if the grade is below XXX, be it so called, or be it known as choice or standard, it is a No. 2, and its value can be fixed only by knowing to what extent the manufacturer looked upon defects as admissable in packing.

The main defects in shingles of any length may be summed up as follows: Bad sawing, the butts not running of even thickness, and the points being clipped or feathered. Bastard sawing, by which the grain of

the timber runs across the shingles in circles instead of straight with the length. Bad jointing, so that one end is wider than the other, or by leaving sap, no matter how slight, or any other defects upon a XXX shingle or its equivalent by any name. Bad packing, leaving open spaces between the shingles: putting shingles that are defective in a bunch of XXX; allowing sap streaks, small knots, shake, rot, bad jointing, clips, or shingles sawed thinner or thicker than their mates, in a bunch along side with them; packing shingles narrower than three inches, or a large number of that width in a bunch; mixing in hard, glassy timber, doty timber, worm eaten or discolored shingles. No brand of shingles need hope to obtain a good reputation in any market where the sorting and packing has not been as carefully performed as it would be if the buyer stood by the packing frame and inspected each shingle separately. Manufacturers cannot too strongly impress upon their packers the fact that every shingle in a bunch must be, and is, by the brand, considered as warranted to be perfect in the grade in which it is packed, and nothing will so soon take a half dollar off the price of a lot of shingles, as the finding of three or four defective pieces in a bunch. When a roof is shingled, there should not be found a single discarded shingle among the debris, and when a manufacturer brands his shingles with any of the marks denoting the highest grade, it is understood by the brand that every shingle is perfect.

A word to mill men on sawing. Never allow a wood butcher to handle a shingle saw; he will spoil more shingles and damage your reputation more than you can estimate. Discard your shingle saw and have it reground as soon as it wears to fourteen guage, unless you prefer to cut your timber into sawdust rather than shingles. The thinner saw you can use the more profit in timber. It pays to get first-class drag saw machinery and sawyers, as well as first-class shingle sawyers—a poor hand is dear, even if he works for nothing and boards himself. A jointer can make a difference of one-third the day's cut by putting the timber in the shaving heap, or by using judgment and trimming only so much as is needed, but always doing that. If you have more than two packers it will pay to keep an assorter to help and to watch them.

Weights of shingles differ according to the character and specific gravity of the timber from which they are cut. In ordinary white pine a car load of 22,000 pounds of green shingles will be about as follows:

18 Inch, Green, 52,000 to 55,000		16 Inch Green, 60,000 to 65,000	
18 " Dry...60,000 " 65.000		16 " Dry...70,000 " 75,000	

The above for an average. The writer has loaded 90,000 eighteen inch shaved shingles, five butts to two and one-fourth inches, shingles one year old, seasoned under cover, on a ten ton rate. One thousand shingles should lay one square, or a space of ten feet by ten feet.

RURAL ARCHITECTURE.

Under this head we present a series of practical plans and suggestions for cheap buildings, adapted to the wants of farm and village residents, which may be found of value to the retail lumberman and builder. It is not intended for a treatise on theoretical Architecture; the design has been to afford some practical hints to those who are not supposed to be familiar with the subject, for the construction of a class of buildings too cheap to admit of securing plans from an architect, and which have not hitherto been considered of sufficient importance to be accorded a place in the numerous expensive works upon Architecture.

The manner in which the plans given in the following pages were obtained particularly commends them to lumbermen and builders. Nearly every design was furnished or suggested to the editor of the NORTHWESTERN LUMBERMAN by subscribers to that paper in different parts of the country, and in every case they represent buildings which have been constructed in those localities, and are there considered models, in their way, either of neatness, or economy, or both. The elevations or perspective views were not furnished, but from the ground plans and general interior arrangement, the architect has prepared them with reference to making the best appearance for the least money possible. In each case, the name and residence of the person furnishing the design is given, and in this connection the reader is urgently requested to send any criticisms, or improvements upon any of them that may be suggested, to the editor of the LUMBERMAN, 154 Lake Street, Chicago, who will gladly give them attention, and embody them in future editions of this little book. Any new plans will also be duly appreciated.

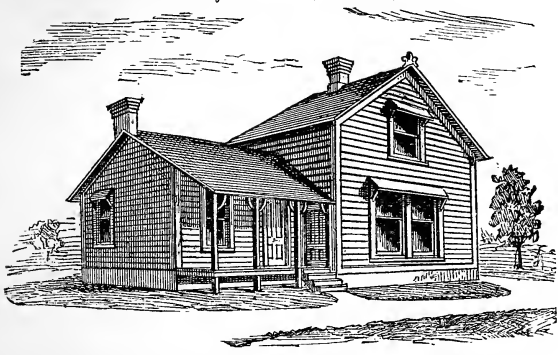
The bill of material required to construct a building after any of the plans given, will undoubtedly meet with more or less criticism and difference of opinion. It is well known, however, that no two architects or builders would figure such a bill precisely alike. The essentials points to make the building reasonable in price have been studiously observed. But it must be borne in mind that much depends upon the locality and surrounding conditions. In one place, for example, good stone for foundations may be had for the gathering; in others, not without considerable expense. Brick may be cheap or costly, according to the quality of the soil; and, most important of all, lumber may cost much or little, accord-

ing to the distance from its point of production. For this reason, no attempt has been made to give the probable cost of any of the buildings; it will be governed entirely by local surroundings.

Again, no one of the designs as they are given may suit the prospective builder, in which event they may be taken as suggestions merely. The uses and arrangement of rooms can be altered from those indicated. Additional doors and windows can be cut, or positions of them changed. In many cases double or bay windows would be an improvement. All chimneys are figured from the ground up; the amount of material would be increased by the introduction of fire-places or grates, and diminished by supporting them near the ceiling by brackets or otherwise. Verandas can be taken off or added; and, in some cases, halls can be incorporated into the rooms. Closets can be added, and such other alterations or additions made as are required, which any lumber dealer can readily make, and keep the run of the necessary material, more or less, in so doing. One man may want his house finished up cheaper and another more expensively than the plans call for, but from the basis herein given it will be found of comparatively little trouble for even those entirely unused to making such figures to make the requisite alterations. Thus, one man might want a house sheathed all over, while another would do away with the greater part of that expense; one would build a brick or stone foundation, if those materials were accessible, while another would economize by setting his building on posts; one would have the joists or studding a foot or more further apart than another, and would think his house unsafe without six, or eight by eight timber for sills, while another would be perfectly contented with the "box" or "Nebraska" pattern, which is much cheaper, as is explained in detail further on; one would want a great deal more finishing lumber used than another and so on. In connection with the plans various suggestions have been made which may be found useful.

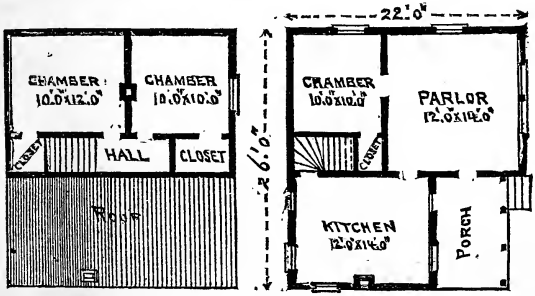
Design 1.

Furnished by S. S. Lowe, Fremont, Neb.



Material Required for Design 1.

2 ps. 6x6 12s. 3 6x6 14s, 2 6x6 22s, for sills; 54 ps. 2x4 14s, studding for main wing; 30 ps. 2x4 8s, studding for kitchen wing; 30 ps. 2x8 14s, for joist; 20 ps. 2x4 16s, for rafters; 34 ps 2x4 10s, for rafters; 1,000 ft. flooring; 1,500 ft. siding; 1,300 ft. sheathing, rough; 150 yards paper; 8,000 shingles; 500 ft. shingle strips; 4 ps. 4x4 10s, for porch posts; 5,000 lath; 350 yds. plastering; 1,000 brick; 268 ft. 6 inch base; 14 4-ft posts for foundation; 11 doors, 9 windows, casings, etc., glass 12x28; 150 ft. cornice moulding.

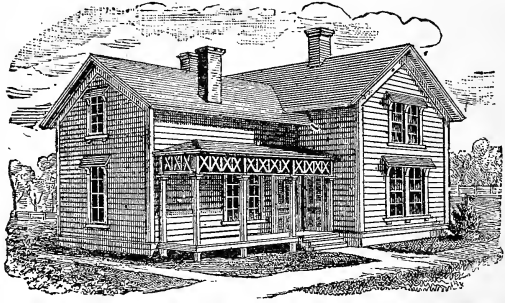


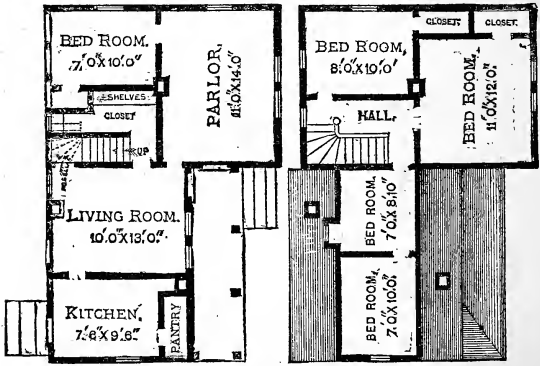
Second Floor. Design 1. Ground Floor.

By opening the closet on the lower floor into the kitchen, instead of into

the bedroom, a small pantry will be obtained, from which a stairway can lead to a cellar, if desired. A large front chamber can be made above by omitting the closet and carrying the partition clear across the house, with a door at the head of the stairs. Instead of the 6x6 sills, 2 2x8 12s, 2 2x6 12s, 3 2x8 14s, 3 2x6 14s, 2 2x8 22s and 2 2x6 22s can be used to make the "Nebraska sill."

DESIGN 2.—ORIGINAL.





GROUND FLOOR. DESIGN 2. SECOND FLOOR.

One chimney can be made to serve for the wing, by having it begin in the partition in the second story, the pipes from below passing through

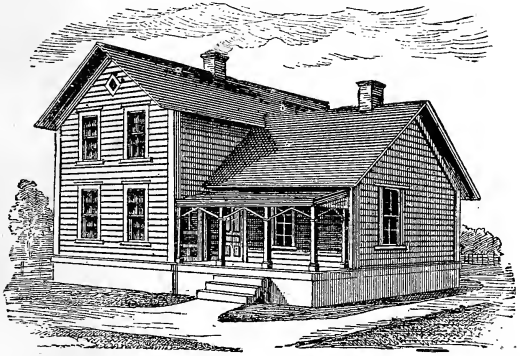
the floor. Three large rooms can be obtained on the lower floor by moving the partition between the kitchen and living room toward the ell, and, instead of the kitchen given in the plan, have a pantry 4x6 ft. and a wood house or laundry 6x9. Also extend the bedroom to the stairway, and connect by a door with the kitchen. It could then be utilized as a dining room.

Material Required for Design 2.

63 ps. 2x4 14s; 54 ps. 2x4 16s; 30 ps. 2x4 10s; 19 ps. 2x4 8s; 37 ps. 2x4 8s, for studding; 39 ps. 2x10 16s; 32 ps. 2x8 14s, floor joist; 27 ps. 2x4 12s; 16 ps. 2x4 14s, ceiling joists; 32 ps. 2x4 10s; 39 ps. 2x4 12s, for rafters: 4 posts, 4x4x8, for porch; 4 posts, 6x6x3, under porch; 2,700 rough sheathing, sides and roof; 8,000 shingles; 7,500 lath; 300 yds. paper, sides and roof; 430 ft. 6 inch base; 24 posts, 4 ft. long, foundations; 3,200 ft. siding; 1,350 ft. flooring; 1,500 brick; 512 yds plastering; 17 doors, 15 windows, casings; Glass, 4-light, 14x48 main windows; 81 lts., 12x18, small windows; 165 lineal ft. cornice moulding; 156 lineal ft. 6x6 for sills.

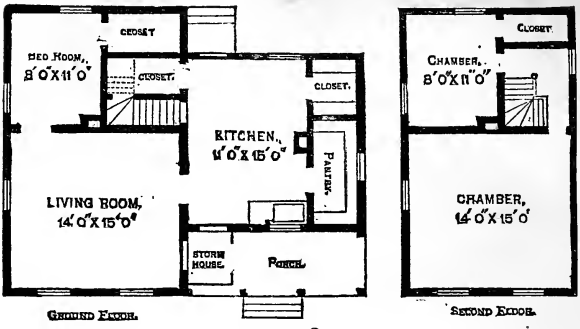
Design 3.

Furnished by Hamlin & Ford, Watertown, Wis.



Material Required for Design 3.

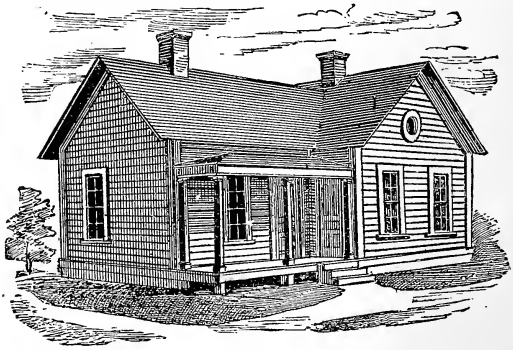
70 ps. 2x4 16s, studdings for main part; 36 ps. 2x4 16s for main partitions; 37 ps. 2x4 9s, studding for wing; 56 ps. 2x8 16s, and 33 ps. 2x6 16s, for joists; 20 ps. 2x4 9s, and 44 ps. 2x4 12s, for rafters; 132 ft. 2x8, 200 ft. 2x4 wall plates; 4 posts 4x4, 16; 2 posts 4x4, 9; 300 lineal ft. bridging and plates, 1x3; 1,000 ft. dressed roof boards; 1,600 ft. sheathing; 32 bunches shingles; 45 lineal ft. 6 in. ridge boards; 1,200 ft. flooring, 1,850 ft. siding; 650 ft. select boards; 50 ft. 1¼ select corner strips; 160 ft. 8-in. base, 160 ft. 6-in. base, 2 cellar windows, frames and sash: 3 outside door frames, doors and casings; 10 inside door frames, 14 window frames, sash and casings; 10,000 brick for foundation and chimneys; 450 yards lath and plastering.



DESIGN 3.

DESIGN 4.

Furnished by J. G. Bettleheim, Brookfield, Mo.

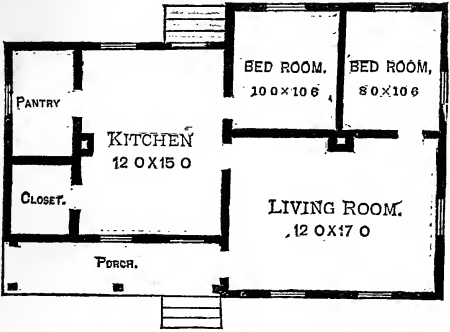


This would make a convenient plan for a story and a half house by raising and lengthening the main part, and running a stairway from the kitchen, between the living room and bed room.

Material Required for Design 4.

1,650 brick for chimney; 347 yds. of plastering; 195 ps. 2x4 14s, studding; 26 ps. 2x4 14s, 18 ps. 2x4 12s, rafters; 8 ps, 2x8 16s, 10 ps. 2x8 14s, 10 ps.

2x8 10s, 13 ps. 2x6 14s. 13 ps. 2x6 10s. 13 ps. 2x6 16s, for joists; 160 lineal ft. 2x8 for sills; 134 lineal ft. 2x4 for plates; 150 lineal ft. 1x3 for bridging; 2,800 ft. sheathing; 2,040 ft. ½-in. siding; 9,000 shingle; 875 ft. of flooring;

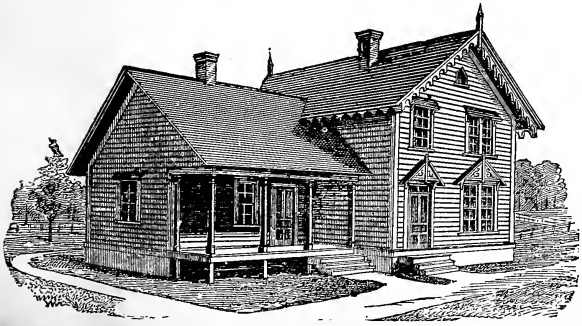


DESIGN 4.

660 ft. 1-in. finishing lumber; 80 ft. 1½-in. finishing lumber; 7 doors, 2-6x6-10x1⅜, 10 windows. 12-light. 12x16; 4 posts for porch, 6x6 10s; 15 posts for house, 8x8 4s; 5,000 lath.

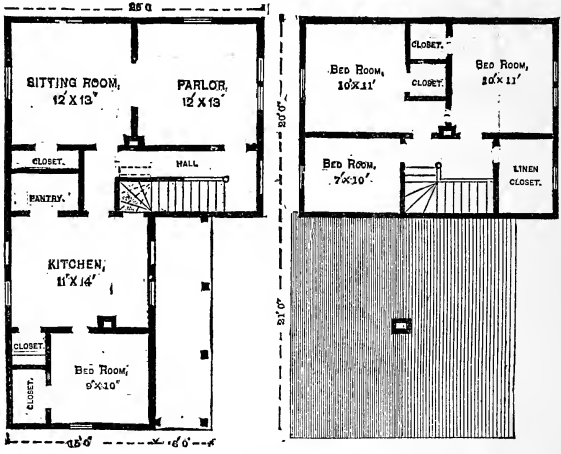
DESIGN 5.

Furnished by J. G. Bettleheim, Brookfield, Mo.



Material Required for Design 5.

2,100 brick for chimneys; 680 yds. plastering; 168 lineal ft. 6x6 sills; 108 ps. 2x4 18s, and 66 ps. 2x4 10s for studs; 60 ps. 2x8 14s and 15 ps. 2x8 16s for floor joists; 20 ps. 2x4 12s and 10 ps. 2x4 16s for ceiling; 300 lineal ft. bridging and ribbon, 1x3; 7 ps. 2x4 16s rafters; 92 lineal ft. 2x4 plates; 3,600 ft. sheathing; 14,000 shingles; 2,600 ft. siding; 1,350 ft. flooring; 500 ft. select for trimming; 3 posts under porch, 6x6x3 ft.; 22 posts under house, 6x6x5 ft.; 3 posts on porch, 4x4x9 ft.; 5 windows, 12-light, 12x16; 9 windows, 12-light, 12x14; 1 double door, 5-0x7-6x1⅜; 1 front door, 3-6x6-10x1¾; 10 doors, 2-8x6-10x1⅛; 4 doors, 2-6x6-10x1⅛; transom over front door, 2-light, 16x18; small window in each main gable, 4-light, 10x12.



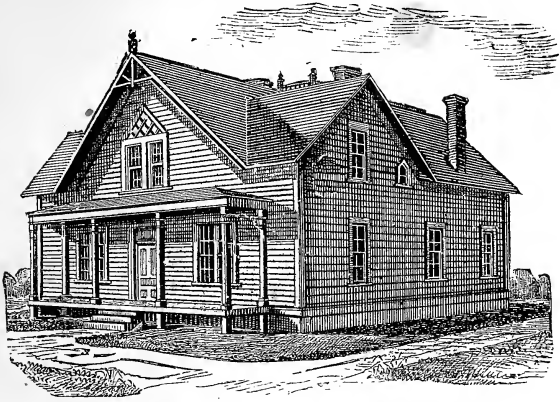
GROUND FLOOR. DESIGN 5. SECOND STORY.

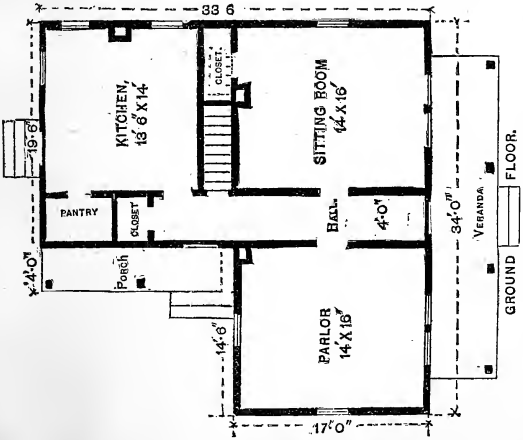
These specifications provide for one window not shown in the plan, viz.: one in the pantry. A bay in place of the double window and a portico at the front door would be desirable changes.

To find the number of bricks required in a building: Rule—Multiply he number of cubic feet by 22½. The number of cubic feet is found by multiplying the length, height and thickness (in feet) together. Bricks are usually made 8 inches long, 4 inches wide and 2 inches thick; hence it requires 27 bricks to make a cubic foot without mortar, but it is generally assumed that the mortar fills 1-6 of the space.

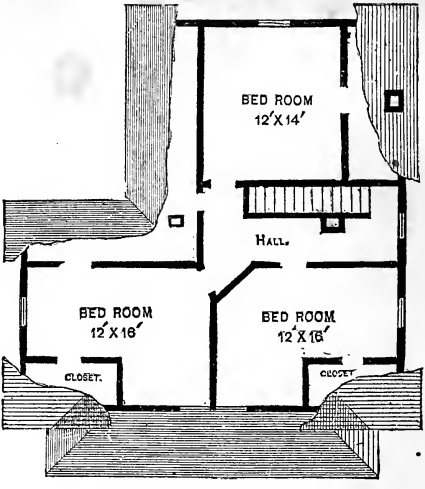
DESIGN 6.

Furnished by J. S. McFeeters, Bedford, Ind.





GROUND FLOOR—DESIGN 6.



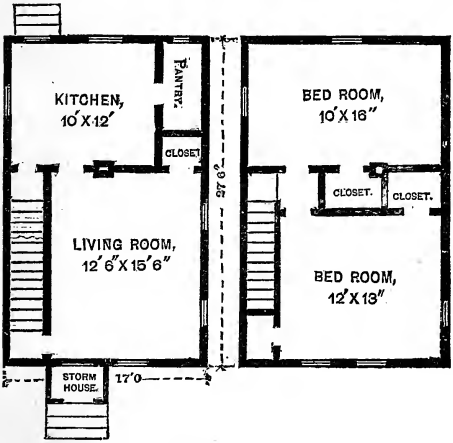
SECOND FLOOR—DESIGN 6.

Material Required for Design 6.

2,500 brick for chimney: 50 yds. plastering; 1,600 ft. flooring; 6,000 ft. sheathing; 4,500 ft. siding; 20,000 shingles: 184 lineal ft. 6x6 sills; 100 ps. 2x4 14s, 63 ps. 2x4 10s, and 126 ps. 2x4 8s, for studs; 80 lineal ft. 2x4 for plates; 16 ps. 2x6 16s, and 74 ps. 2x8 14s for floor joists; 36 ps. 2x4 12s for ceiling; 38 ps. 2x6 12s, and 24 ps. 2x6 18s for rafters; 400 lineal ft. 1x3 for bridging, etc.; 6 windows, 8-light, 12x18; 3 windows, 12-light, 12x16; 6 windows, 8-light, 12x14; 1 door, 3-0x6-10x1¾; 4 doors, 2-8x6-10x1⅛; 8 doors, 2-6x6-10x1⅛; 5 doors, 2-2x5-6x1⅛; 4 posts, 4x4x3 ft., 4 posts, 4x4x9 ft.; 22 posts, 6x6x5 ft.; 400 ft. of select.

Partitions unsupported from underneath the floors should be supported from the walls by means of a simple truss. This can be made by setting two pieces of scantling into the walls on either side, at the floor, to abutt against each other at the ceiling or against a collar-beam over the doors. This plan will obviate the sinking of floors so often seen under partitions.

DESIGN 7—ORIGINAL.



GROUND FLOOR. DESIGN 7. SECOND FLOOR.

Material Required for Design 7.

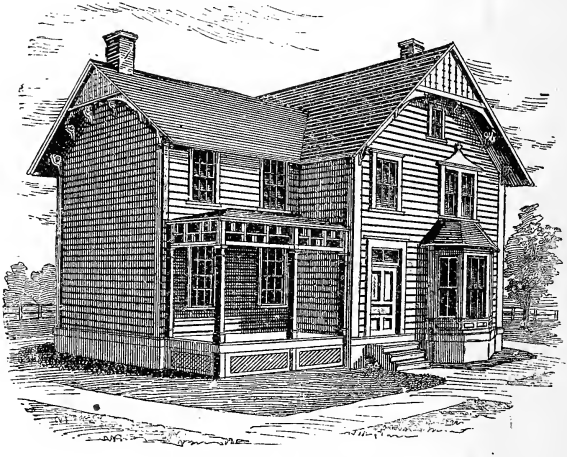
110 lineal ft. 6x6, for sills; 100 ps. 2x4 14s, for studs; 52 ps. 2x8 14s, for floor joists; 26 ps. 2x4 14s, for ceiling joists; 250 lineal ft. 1x3, bridging.

etc.; 26 ps. 2x4 10s, for rafters; 55 lineal ft. 2x4 plates; 2,100 ft. sheathing; 6,000 shingles: 1,600 ft. siding; 850 ft. flooring (surface measure); 200 ft. select for trimming; 13 posts 6x6x5 ft., under house; 10 windows, 12-light, 12x14; 1 window, 8 light, 10x14; 8 doors, 2-8x6-10x1⅛; 2 doors, 2-6x6-10x1⅛, 1 door, 2-8x6-10x1⅜, front: transom front door, 2-light 12x16: 960 brick for chimney; 410 yards plastering

These specifications call for 6x6 sills, but the framed sill can be substituted with either stone or post foundation.

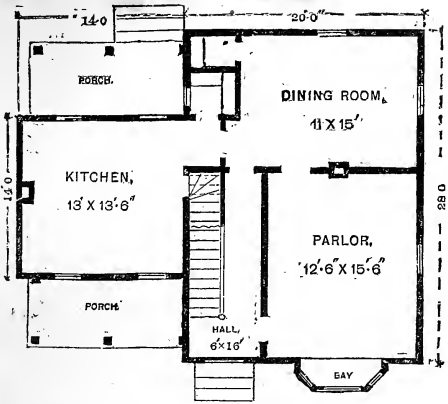
Design 8.

Furnished by B. F. Blaker, Pleasanton, Kansas.

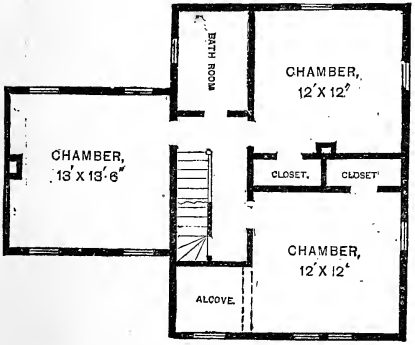


Material Required for Design 8.

2,400 brick for chimneys; 700 yds. plastering; 166 lineal ft. 6x6 sills (under center of main part, so as to use 10-ft. joists); 156 ps. 2x4 18s studs; 42 ps. 2x6 10s, and 22 ps. 2x8 14s for floor joists; 52 ps. 2x4 14s for ceiling; 300 lineal ft. 1x3 for bridging and ribbons; 30 ps. 2x4 16s. and 16 ps. 2x4 10s for rafters; 84 lineal ft., 2x4 plates; 3,800 ft. sheathing; 11,000 3,200 ft. siding; 1,750 ft. flooring; 600 ft. select for trimming; 4 posts under porches, 6x6 3 ft.; 22 posts under house, 6x8 5 ft.; 4 posts on porch, 4x4 10 ft.; 3 windows, 6-light, 12x32; 3 windows, 12-light, 12x16; 1 window, 8-light, 12x16; bay window, 6-light, 12x32, and 4-light, 16x32; 5 windows, 6-light, 12x28; 5 windows, 12-light, 12x14; 12 doors, 2-8x6-10x1⅛; 1 door, 2-2x6-10x1⅛; 1 door, 2-10x6-10x1¾ (front); transom over front door, 2-light, 16x14; window, each end main gable, 4-light, 10x16.



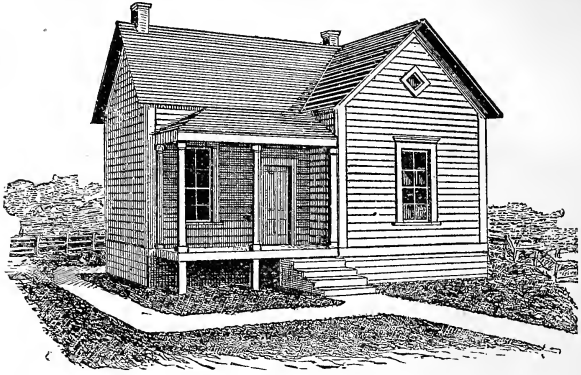
GROUND FLOOR—DESIGN 8.

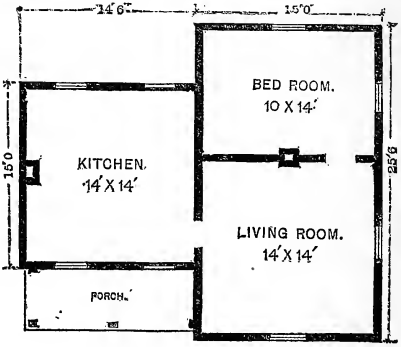


SECOND STORY—DESIGN 8.

DESIGN 9.

Furnished by B. F. Blaker, Pleasanton, Kan.





GROUND FLOOR—DESIGN 9.

Material Required for Design 9.

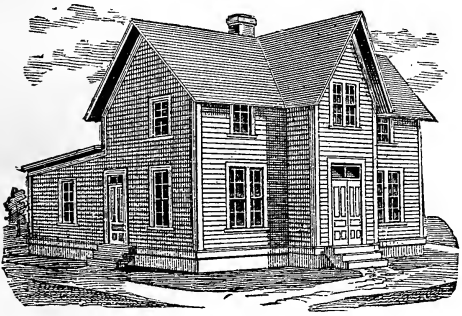
1,680 brick for chimneys; 220 yds. plastering; 120 lineal ft. 6x6 sills; 124 ps. 2x4 12s for studs; 20 ps. 2x8 14s floor joists, 2 ft. apart; 30 ps. 2x4 14s ceiling joists; 200 lineal ft. for bridging, etc., 1x3; 32 ps. 2x4 10s for rafters; 110 lineal ft. 2x4 for plates; 2,200 ft. sheathing; 8,500 shingles; 1,400 ft. siding (surface); 650 ft. flooring; 330 ft. select for trimming; 2 posts under porch, 4x6 3 ft.; 20 posts under house, 6x6 5 ft.; 2 posts on porch,

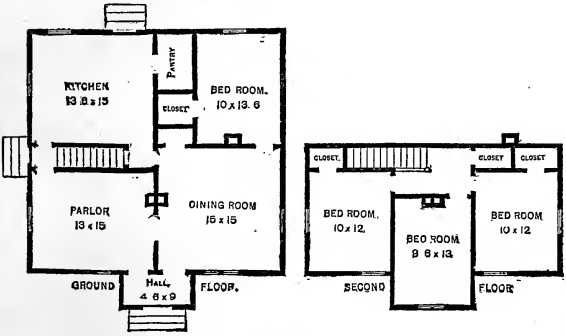
4x4 9 ft.; 6 windows, 8-light, 10x14; 4 doors, 2-6x6-10x1⅛; small window, each end main gable, 4-light, 10x10; 3,500 lath.

The outside dimensions of this house should be 14x26 and 14x14, with interior dimensions altered to correspond.

DESIGN 10.

Furnished by Carnagie, Prescott & Co., Portage, Wis.





DESIGN 10.

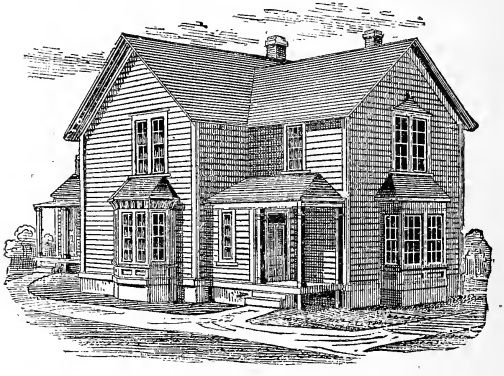
Material Required for Design 10.

2,700 brick for chimneys; 500 yds. plastering; 1,500 ft. flooring; 3,000 ft. sheathing; 15,000 shingles; 1,850 ft. siding; 69 ps. 2x4 14s, 34 ps. 2x4 9s,

115 ps. 2x4 8s for studs; 155 lineal ft. 6x6 sills; 70 ps. 2x8 16s, floor joists; 48 ps. 2x4 16s, for ceiling joists; 31 ps. 2x4 14s, and 16 ps. 2x4 16s, rafters; 300 lineal ft. 1x3, bridging, etc.; 93 lineal ft. 2x4 plates; 4 windows, 8-light, 10x16; 6 windows, 8-light, 12x14; 2 windows, 4-light, 12x14; 4 windows, 6-light, 12x16; 2 doors, 2-4x6-10x1⅜; 3 doors, 2-10x6-10x1⅜; 4 doors, 2-8x6-10x1⅜; 4 doors, 2-6x6-10x1⅜; 400 ft. select.

DESIGN 11.

Furnishsd by Carnagie, Prescott & Co., Portage, Wis.

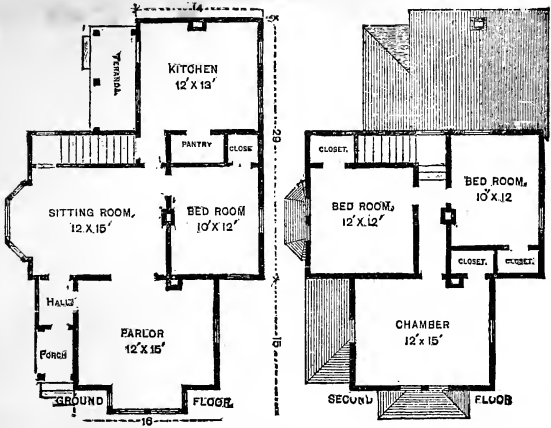


Material Required for Design 11.

2,200 brick for chimneys; 600 yds. plastering; 148 lineal ft. 6x6 sills; 28 ds. 2x4 9s, and 128 ps. 2x4 16s for studs; 26 ps. 2x8 16s and 26 ps. 2x8 12s, and 8 ps. 2x8 14s for floor joists; 14 ps. 2x4 16 and 14 ps. 2x4 12s, and 8 ps. 2x4 14s for ceiling joists; 300 lineal ft. 1x3 for bridging; 45 ps. 2x4 14s, and 13 ps. 2x4 12s for rafters; 100 lineal ft. 2x4 plates; 20,000 shingles; 4,000 tf. sheathing; 2,300 ft. siding (surface); 1,350 ft, flooring; 3 posts, 4x4 3 ft.; 3 posts, 4x4 9 ft.; 21 posts, 6x6 5 ft.; 3 6-light, 12x16, and 1 6-light, 14x16 for bay windows; 7 windows, 12-light, 12x16; 4 windows, 12-light, 12x14; 5 windows, 8-light, 12x14; 4 doors, 2-10x6-10x1⅜; 6 doors, 2-8x6-10x1⅜; 6 doors, 2-6x6-10x1⅜; 2 doors, 2-6x7-6x1⅜; 300 ft. select.

If light is wished in the pantry, it could change position with the closet

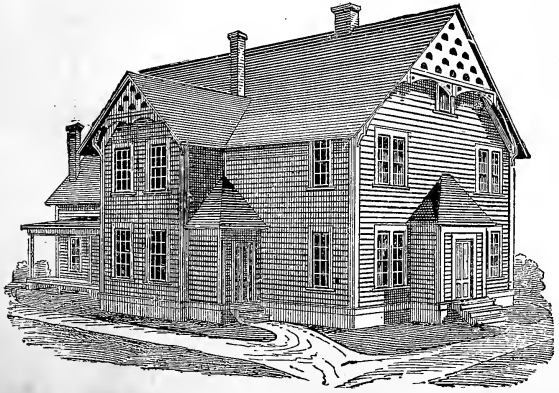
To find the number of shingles required in a roof: Rule—Multiply the number of square feet in the roof by 8, if the shingles are exposed 4½ inches, or by 7 1-5 if exposed 5 inches.

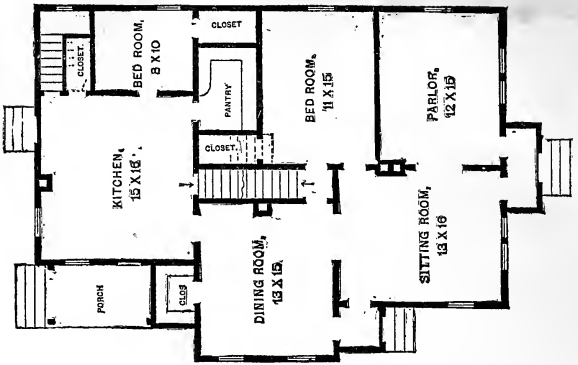


DESIGN 11.

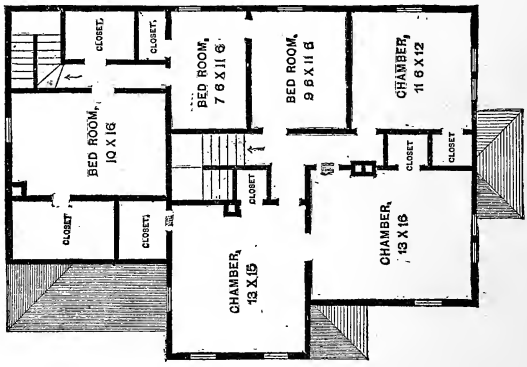
DESIGN 12.

Furnished by Carnagie, Prescott & Co., Portage, Wis.





GROUND FLOOR—DESIGN 12.



SECOND STORY—DESIGN 12.

Material Required for Design 12.

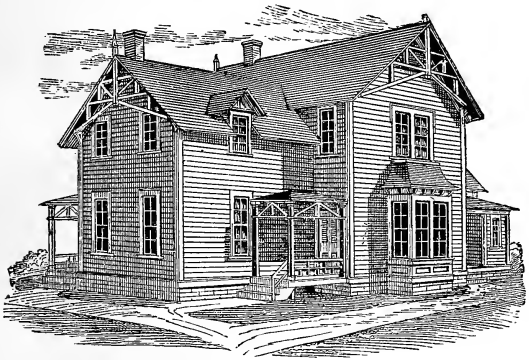
3,500 bricks for chimneys; 1.150 yds. plastering; 2,100 ft. flooring; 5,504 ft. sheathing; 3.800 ft. siding; 23.000 shingles; 226 lineal ft. 6x6 sills; 90 lineal ft. 2x4 plates; 500 lineal ft. 1x3 bridging, etc.; 124 ps. 2x4 18s, 48 ps. 2x4 14s, 58 ps. 2x4 9s, 128 ps. 2x4 8s, for studs; 26 ps. 2x8 14s, and 92 ps. 2x8 16s, for floor joists; 13 ps. 2x4 14s, and 46 ps. 2x4 16s, for ceiling joists;

24 ps. 2x6 18s, 12 ps. 2x4 12s, and 18 ps. 2x4 16s for rafters; 500 ft. select for trimming; 4 windows, 8-light, 12x16; 5 windows, 12-light, 12x16; 1 window, 8-light, 10x14, 11 windows, 12-light, 10x14; 4 windows, 8-light, 12x14; 4 doors, 2-10x6-10x1⅜; 4 doors, 2-6x7-6x1⅜; 8 doors, 2-8x6-10x1⅜; 19 doors, 2-6x6-10x1⅜; 4 doors, 2-4x6-0x1⅜; 1 post 4x4x3 ft.; 1 post 4x4x9 ft.; 33 posts, 6x6x5; 4 transom, each 2-light, 15x16. The extreme outside measurement of this house is 36x47 ft.

Plan 12 is of a house designed to accommodate a large family in a very comfortable manner, and yet at a comparatively small expense. It is thoroughly provided with closets, etc., and all parts are convenient of access. Probably any person adopting it would make some changes, while following the general plan. The number of rooms could be reduced, and some enlarged. It is suggested that the front entrance be omitted, and the side entrance connected with the stairway by a hall.

Design 13.

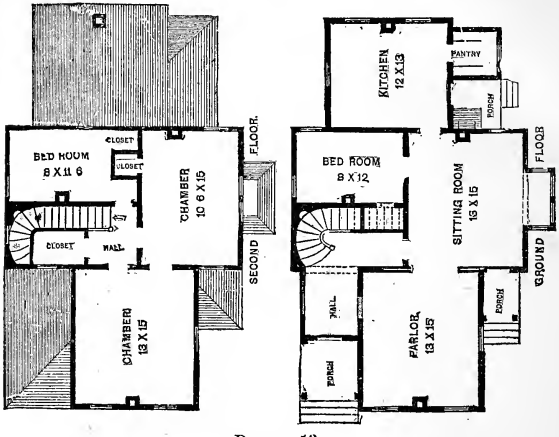
Furnished by Edwards, Weaver & Co., Aledo, Ill.



Material Required for Design 13.

3,200 brick for chimneys; 660 yds. plastering; 1,400 ft. flooring; 4,300 ft. sheeting; 3,500 ft. siding; 14,000 shingles; 40 ft. tin roof; 147 lineal ft. 6x6 sills; 106 lineal ft. 2x4 plates; 300 lineal ft. 1x3 bridging, etc.; 84 ps. 2x4 20s, 35 ps. 2x4 14s, 58 ps. 2x4 10s, and 14 ps. 2x4 8s for studs; 77 ps. 2x8 14s for floor joists; 34 ps. 2x4 12s for ceiling joists; 29 ps. 2x4 10s, and 26 ps. 2x4 12s for rafters; 500 ft. select for trimming; 3 doors, 2-10x7-6x1⅜; 2 doors, 2-6x8-0x1⅜; 3 doors, 2-8x7-6x1⅜; 9 doors, 2-6x6-10x1⅜; 5 windows, 12-light, 12x18; 2 windows, 8-light, 10x16; 4 windows, 8-light, 16x18; 2 windows, 8-light, 16x18, and 2 windows, 4-light, 18x18 for bay; 5 win-

dows, 12-light, 12x14; 2 windows, 8-light, 12x14; 1 window, 6-light, 12x14; 2 posts, 4x4 3 ft ; 2 posts, 4x4 10 ft.; 28 posts, 6x6 5 ft.; 3 transoms, each 2-light, 15x18.



DESIGN 13.

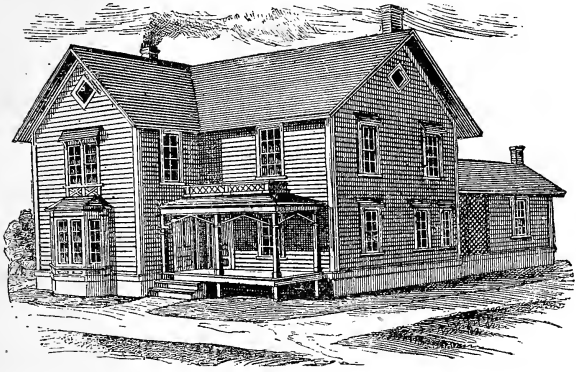
This plan we consider a particularly fine one in arrangement, but should be placed in a position which does not require a well defined front. The front of the house, as far as arrangement is concerned, is that turned to the left in the perspective view. If the house is to occupy a prominent position, its appearance would be much improved by making the front 16 feet wide and 2 full stories high, and putting a bay window in front of the parlor, and transferring the chimney to the side.

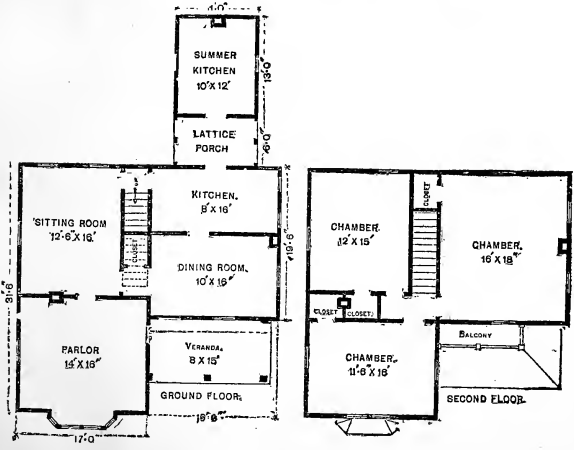
Tin roofing is measured by the square of 100 superficial feet; hips, valleys and flashings, by the foot lineal.

A box of roofing tin contains 112 sheets, 14x20 inches, and weighs from 110 to 145 pounds per box. The Pontymiester, M. F. and other good brands of I. C. charcoal tin, weighing an average of 112 pounds per box, or 1 pound per sheet, and X tin 140 pounds per box, or 1¼ pounds per sheet. Roofing tin can now be had *double* size, or 20x28 inches, weighing, I. C. 225 pounds per box, and X tin 285 pounds per box. This latter size is the most economical in its use, saving the material and labor of one-fourth of the seams and ribs.

Design 14.

Furnished by W. Menefee, Boswell, Ind.



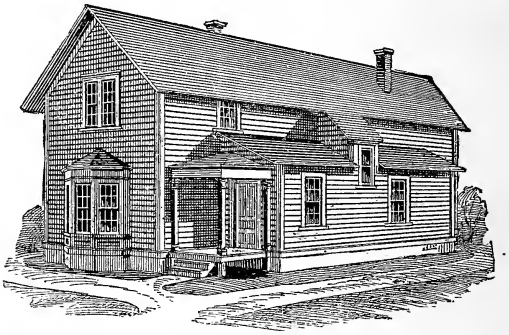


Design 14.

Material Required for Design 14.

2,200 brick for chimneys; 640 yds. plastering; 198 lineal ft. 6x6 sills; 170 ps. 2x4 16s for studs; 43 ps. 2x6 10s, 50 ps. 2x6 14s, and 26 ps. 2x6 8s for floor joists; 26 ps. 2x4 10s, 25 ps. 2x4 14s, and 13 ps. 2x4 8s for ceiling; 500 lineal ft. 1x3 for bridging, etc.; 32 ps. 2x4 14s, 17 ps. 2x4 16s, 19 ps. 2x4 10s for rafters; 134 lineal ft. 2x4 plates; 3,500 ft. sheathing; 14,000 shingles; 2,350 ft. flooring; 2,500 ft. siding; 600 ft. select; 2 posts, 4x4 3 ft.; 2 posts, 4x4 9 ft.; 26 posts, 6x6 5 ft.; 6 windows, 12-light, 12x16; 9 windows, 12-light, 12x14; 3 windows, 8-light, 12x16; 8-light window, 12x16, and 8-light window 14x16 for bay; 2 doors, 2-10x7-6x1⅜; 11 doors, 2-8x6-10x1⅛; 4 doors, 2-6x6-10x1⅛.

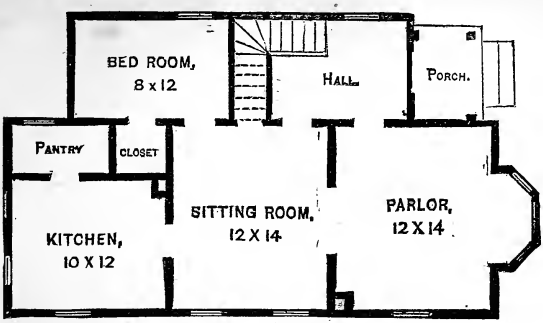
Design 15.



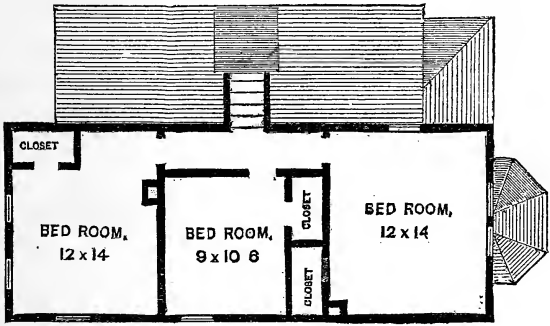
Material Required for Design 15.

1,800 brick for chimneys; 525 yds. plastering; 1,300 ft. flooring; 3,000 ft. sheathing; 2,000 ft. siding; 13,000 shingles; 80 ps. 2x4 16 ft., 40 ps. 2x4 9 ft., 68 ps. 2x4 8 ft. for studs; 98 lineal ft. 2x4 for plates; 144 lineal ft. 6x6 for sills; 58 ps. 2x8 14s, and 17 ps. 2x6 8s for floor joists; 29 ps. 2x4 14s, and 17 ps. 2x4 8s for ceiling; 38 ps. 2x4 14s, and 12 ps. 2x4 10s for rafters; 250 lineal ft. 1x3 for bridging, etc.; 8-light window, 14x16, and 16-light window, 10x16 for bay; 7 windows, 12-light, 10x16; 6 windows, 12-light, 10x14; 1 door, 3-0x6-10x1⅜; 2 doors, 2-4x6-10x1⅜; 4 doors, 2-8x6-10x1⅛; 9 doors, 2-6x6-10x1⅛; 1 post, 4x4 3 ft.; 1 post, 4x4 9 ft.; 20 posts, 6x6 5 ft.; 1 window, 2-light, 12x24; 300 ft. select.

Plan No. 15 is designed for a cheap city or village residence, where space is limited. It is but 23 feet wide on the outside, and has a very convenient arrangement of rooms. The wing, when another house adjoins it, would be better built with a flat roof, and if the house is isolated, the wing should have a gable roof with the ridge over the stair-way



GROUND FLOOR

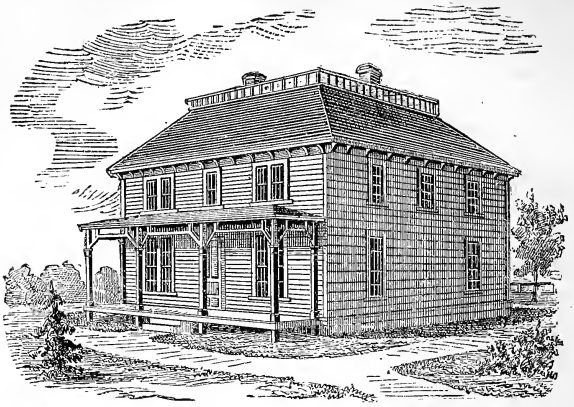


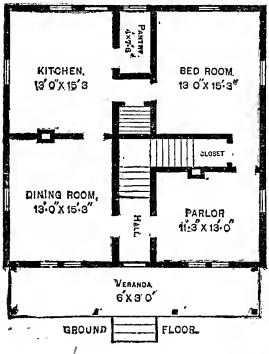
SECOND FLOOR.

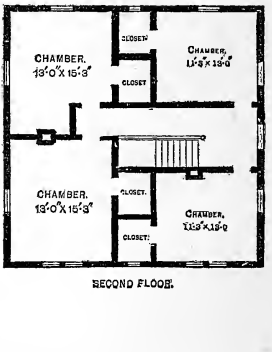
DESIGN 15.

Putty, in plastering, is a very fine cement made of lime only. It is thus prepared: dissolve in a small quantity of water, as two or three gallons, an equal quantity of fresh lime, constantly stirring it with a stick until the lime be entirely slaked, and the whole becomes of a suitable consistency, so that when the stick is taken out of it, it will but just drop therefrom; this, being sifted or run through a hair sieve, to take out the gross parts of the lime, is fit for use. Putty differs from fine stuff in the manner of preparing it, and in its being used without hair.

DESIGN 16—ORIGINAL.







DESIGN 16.

Material Required for Design 16.

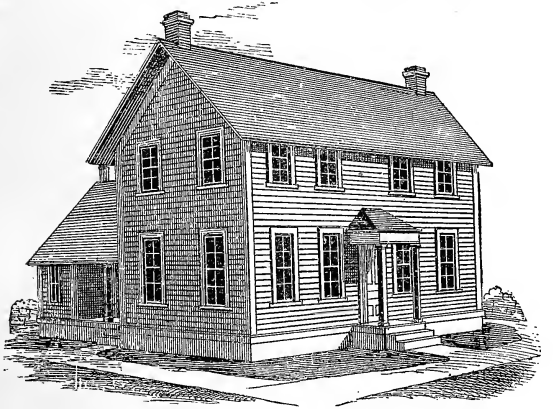
1,800 brick for chimneys; 800 yds. plastering; 2,200 ft. flooring; 3,450 ft. sheathing; 2,450 ft. siding; 12,000 shingles; 2½ sq. tin roof; 175 p 2x4 16s. for studs; 128 lineal ft. 2x4 plates; 192 lineal ft. 6x6, sills; 100 p

2x8 14s, floor joist; 50 ps. 2x4 14s, ceiling; 48 ps. 2x4 12s, and 13 ps. 2x8 16s, rafters; 250 lineal ft. 1x3 bridging, etc.; 4 posts, 4x4 3 ft.; 4 posts, 4x4 8 ft.; 22 posts, 6x6 5 ft.; 4 windows, 12-light, 10x18; 7 windows, 12-light, 12x16; 11 windows, 6-light, 10x16; 2 windows, 2-light, 12x16; 2 doors, 2-10x6-10x1⅜; 5 doors, 2-8x6-10x1⅜; 11 doors, 2-6x6-10x1⅜; 500 ft. select.

In this house the square form is used as it contains the most room possible for a given amount of material. Each bedroom is provided with a closet, and the partitions in the second story, with one exception, rest on those below, thus preventing any sinking of floors.

DESIGN 17.

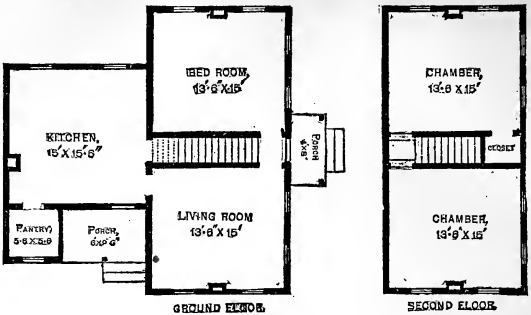
Furnished by Wilhelm & Martin, New Waterford, Ohio.



Material Required for Design 17.

2,700 brick for chimneys; 540 yds. plastering; 1,350 ft. flooring; 3,900 ft. sheathing; 2,800 ft. siding; 15,000 shingles; 96 ps. 2x4 18s for studs; 162 lineal ft. 6x6 for sills; 62 ps. 2x4 9s for studs; 94 lineal ft. 2x4 for plates; 60 ps. 2x8 16s for floor joists; 40 ps. 2x4 16s for ceiling joists; 50 ps. 2x4 14s for rafters; 250 lineal ft. 1x3 for bridging, etc.; 3 posts, 4x4 3 ft.; 3 posts, 4x4 9 ft.; 19 posts. 6x6 5 ft.; 8 windows, 4-light, 12x30; 3 windows 4-light, 12x14; 8 windows, 4-light, 12x28; 2 doors. 2-8x6-8x1⅜; 8 doors, 2-6x6 8x1⅜; 400 ft. select for trimmings.

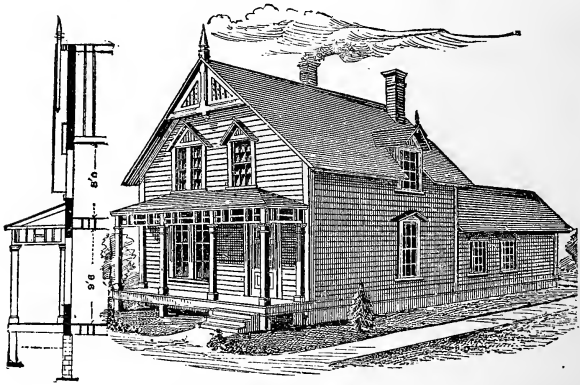
Dry sand weighs, per cubic foot, 95 pounds, quick-lime 50 pounds, and compact clay 135 pounds.



DESIGN 17.

DESIGN 18.

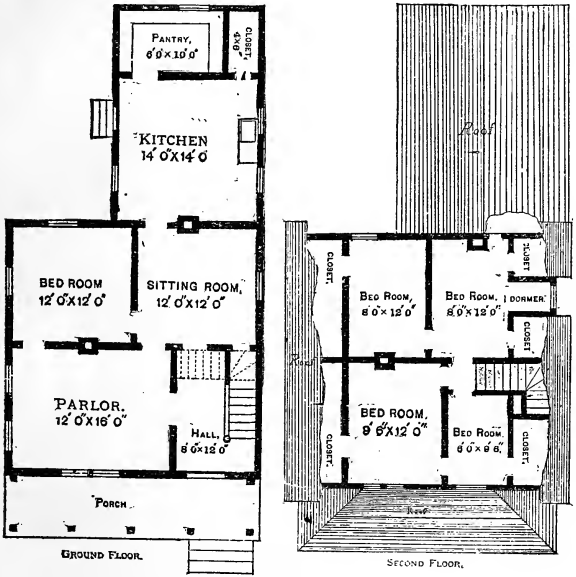
Furnished by Payne & Spates, Kansas, Ill.



Material Required for Design 18.

2,000 brick for chimneys; 680 yds. plastering; 210 lineal ft. 6x8 for sills; 112 ps. 2x4 16s, and 60 ps. 2x4 10s for studs; 152 ps. 2x8 14s, 62 ps. 2x8 16s for floor joists; 76 ps. 2x4 14s, and 62 ps. 2x4 16s for ceiling joists; 400

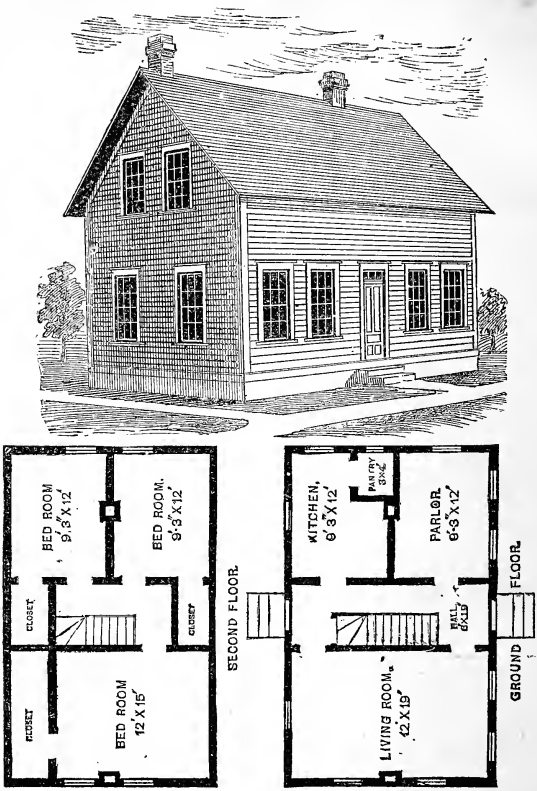
lineal ft. 1x3 for bridging and ribbons; 30 ps. 2x6 20s, and 24 ps. 2x4 14s for rafters; 94 lineal ft. 2x4 for plates; 3,500 ft. sheathing for sides and roof; 15,000 shingles; 1,800 ft. flooring; 2,400 ft. siding; 600 ft. select for trimmings; 5 ps. 4x4 10 ft. cased up for veranda posts; 5 posts, 6x6 3 ft. under veranda; 29 posts, 8x8 5s under house; 4 windows, 12-light, 10x16; 1 double window, 16-light, 10x16; 6 windows, 8-light, 14x18; 1 double window, 8-light, 14x18; 3 windows, 12-light, 10x16; 13 doors, 2-6x6-10x1⅜; 7 doors, 2 6x7-6x1⅜; double doors front (each) 2-2x7-6x1⅜; transom over front door, 2-light, 12x24.



DESIGN 18.

Building paper has made a wonderful improvement in the comfort of cheap wooden buildings. Not many years ago it was necessary to cover the frame of a house with matched stuff to insure warmth; now any common stuff, if it be covered with paper, will do. But paper should be used not only on the sides, but on either the roof or the ceiling joists. Paper, laid on strips midway of the depth of the studs, thus making two air spaces, will increase the warmth of a house twenty-five per cent.

Design 19.



Design 19.

Material Required for Design 19.

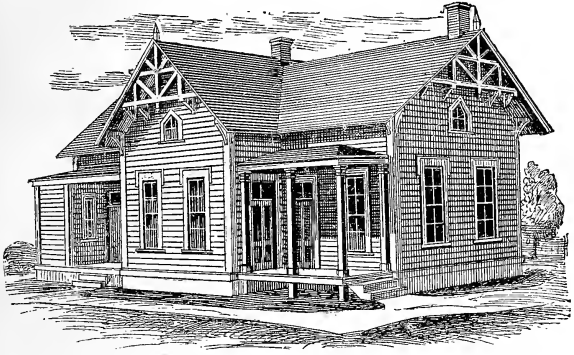
2,000 brick for chimneys; 580 yds. plastering; 1,300 ft. flooring; 2,700 ft. sheathing; 10,000 shingles; 2,000 ft. siding; 80 ps. 2x4 14s, and 50 ps.

2x4 18s for studs; 64 lineal ft. 2x4 for plates; 136 lineal ft. 6x6 for sills; 96 ps. 2x8 10s for floor joists; 48 ps. 2x4 10s for ceiling joists; 33 ps. 2x6 16s for rafters; 200 lineal ft. 1x3 for bridging, etc.; 300 ft. select for trimming; 15 posts, 6x6 5 ft.; 10 windows, 12-light, 12x16; 1 window, 8-light, 10x16; 4 windows, 12-light, 12x14; 2 doors, 2-8x6-8x1⅜; 11 doors, 2-6x6-8x1⅜.

Design 19 can be put up for a very small sum, and yet offers conveniences not found in many more expensive houses. A hall we consider very desirable, but if any one should wish to economize room, it could be done by leaving only an entry-way at the front and enlarging the kitchen. This plan is a modification of one given in Appleton's Cyclopædia of Drawing as a typical one, embracing all the advantages possible in so small a space and for so small an expenditure.

Design 20.

Furnished by W. J. Fleming, Whiting, Kan.

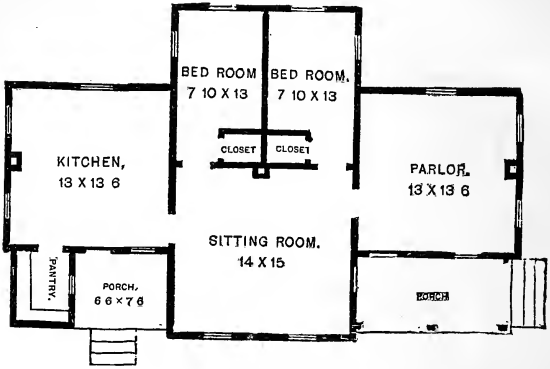


Material Required for Design 20.

2,200 brick for chimneys; 380 yds. plaster; 850 ft. flooring; 3,950 ft. sheathing; 2,900 ft. siding; 15,000 shingles; 168 lineal ft. 6x6 for sills; 82 lineal ft. 2x4 for plates; 138 ps. 2x4 14s, and 88 ps. 2x4 10s for studs; 24 ps. 2x8 14s, and 24 ps. 2x8 16s for floor joists; 24 ps. 2x4 14s, and 24 ps. 2x4 16s for ceiling joists; 30 ps. 2x6 14s, and 26 ps. 2x6 12s for rafters; 56 ps. 1x6 10s ties to rafters; 200 lineal ft. 1x3 for bridging, etc.; 300 ft. select for trimming; 2 posts, 4x4 3 ft.; 2 posts, 4x4 9 ft.; 22 posts, 6x6 5 ft.; 6 windows, 12-light, 12x18; 8 windows, 8-light, 12x16; 1 window, 4-light, 12x16; 8 windows, 8-light, 10x14; 3 doors, 2-8x6-10x1⅜; 7 doors, 2-6x6-10x1⅜.

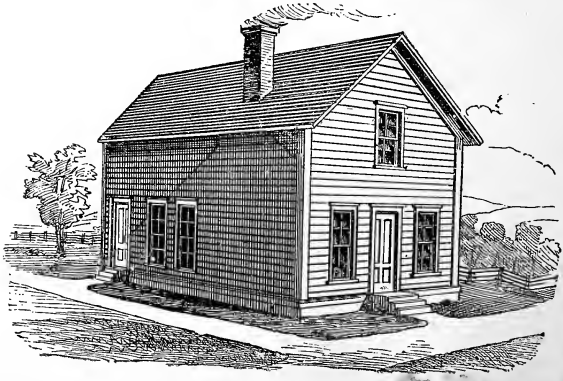
This is a remarkably neat and compact plan for a 1-story house. A very fine effect is produced in its appearance by making the roofs full pitch

and heavily ornamenting the gables; but all superfluous ornament has been thrown out, as the object of this work is to produce cheap plans, as far as is consistent with good taste and the comfort of the future occupant.



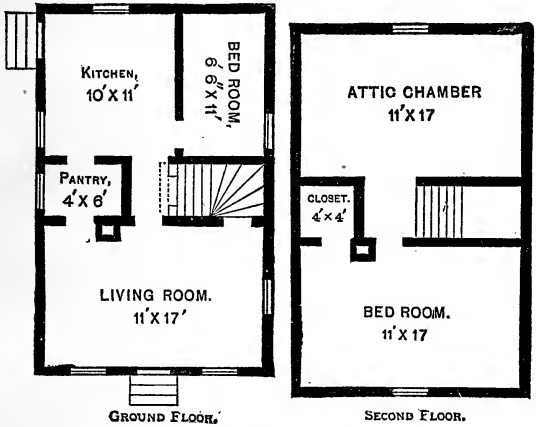
DESIGN 20.

DESIGN 21.



Material Required for Design 21.

785 brick for chimney; 288 yds. plastering or paper; 750 ft. flooring (surface); 2,346 ft. sheathing (surface); 6,750 shingles; 1,740 ft. ½-in. siding; 100 ps. 2x4 14s, 37 ps. 2x4 10s, and 52 ps. 2x4 12s for studding; 9 ps. 2x8 16s, 9 ps. 2x6 12s, 9 ps. 2x6 16s, and 9 ps. 2x8 12s for joists, and 8 ps. 2x4 16s for collar joists; 6 2x8 14s, and 2 2x8 18s for sills; 3 2x12 16s for joists; 606 ft. in. finishing lumber, and 75 ft. 1½-in. finishing lumber; 7 windows, 8-lights, 10x16; 7 doors, panel 2-8x6-8x1⅜; 4,000 lath.



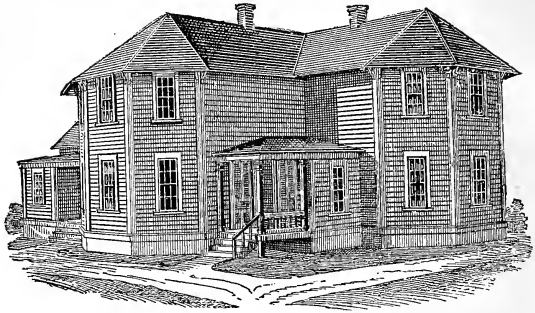
DESIGN 21.

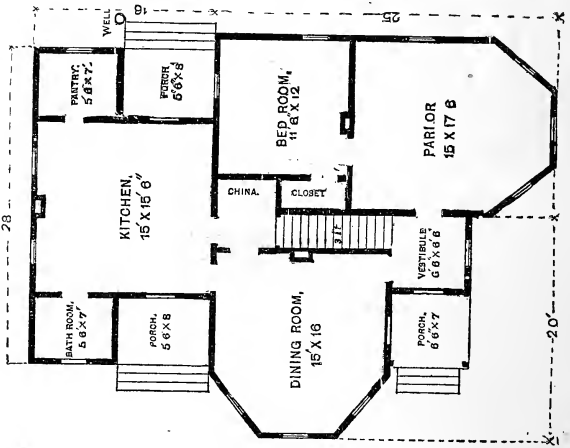
The plan of this house was suggested by Mr. Geo. W. Ware, of Jerseyville, Ill., and is designed to reduce the expense to the minimum. It is 18x28 ft. outside, has 14 ft. studding, roof one-half pitch, and the stories are 9 ft. and 8 ft. in the clear, respectively.

Building contracts, as all other business arrangements, should be written. A few moments' time spent in stating, clearly and concisely, what is expected of each party will often save delays and annoyances during the progress of the work and endless litigation after it. The mechanic's lien laws are a sufficient protection to the contractor or material man, but their enforcement is much more simple and prompt if action can be based on a written contract.

DESIGN 22.

Furnished by R. M. Pinkerton, Viola, Ill.



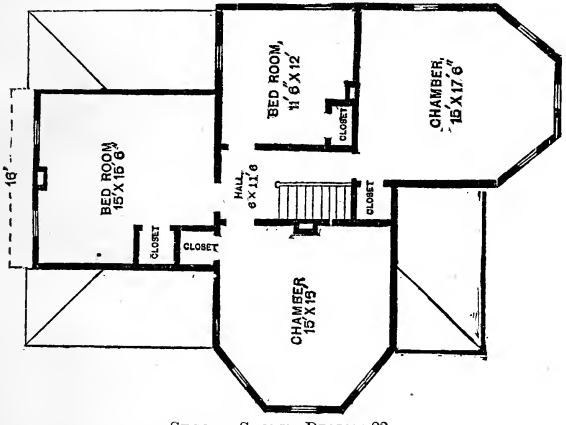


GROUND FLOOR—DESIGN 22.

Material Required for Design 22.

3,000 brick for chimneys; 750 yds. plastering; 136 lineal ft. 6x8 sills; 68 ps. 2x8 16s, 26 ps. 2x8 14s, and 40 ps. 2x6 20s for joists; 175 ps. 2x4 18s for

studs and partitions; 10 ps. 4x4 18s for corner posts; 60 ps. 2x4 12s, 30 ps. 2x4 14s, and 70 ps. 2x4 16s for rafters, etc.; 2,500 ft. flooring; 2,500 ft. common dressed boards for lining; 1,500 ft. No. 2 boards sheathing roof; 14,000 shingles; 2,500 ft. siding; 400 ft. wainscoting; 2,500 ft. 1-in. finishing lumber, dressed; 500 ft. 1¼-in. finishing lumber, dressed; 6 ps. 2x8 16s dressed; 20 ps. 2x6 18s dressed; 11,000 lath; 250 ft. 2-in. plank for steps and platform; 200 ft. 2½-in. bead moulding; 16 brackets, 3¾ in. face; 8 cords stone for foundation in cellar; 8 bbls. lime for cellar; 240 ft. cut. stone for top of wall; 2,000 brick and 2 bbls. cement for cistern under bath-room; 13 doors, 2-8x7 1⅜. 3 of them glazed; 7 doors, 2 6x6-6 1⅜; 13 windows, 4-light, 12x32; 12 windows, 4 light, 12x28; 2 windows, 2-light, 12x16.

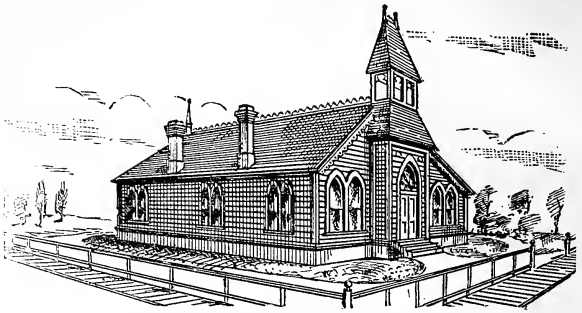


SECOND STORY—DESIGN 22.

The cut does not do justice to the appearance of this house. It is finely proportioned, and thoroughly convenient and complete. Its cost would be from $1,400 to $1,800, according to the location and the material used. Its owner laid hardwood floors on the lower floor of the back wing, and used moulding of two members on two rooms and the hall.

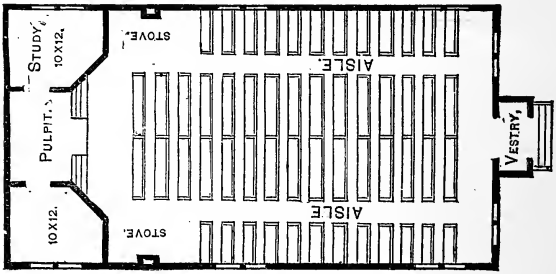
Chimneys, in these specifications, are estimated from the foundation up, and wherever it is consistent with the required cost of the building they should be so made. But there is no particular value to be gained if they are used merely to receive pipes from stoves or furnaces. They should be constructed with several flues. A two-story house should have three; the central one a smoke flue, and the others for ventilation.

Design 23.



Material Required for Design 23.

200 ps. 2x4 20s for studding; 13 ps. 8x8 20s. for sills; 45 posts 8x8 6 ft.; 5 trusses 8x8, 35 ft. for span; 192 ps. 2x6 10s for rafters; 2,400 ft. rough sheathing for side; 2,000 ft. rough sheathing for roof; 3,000 ft. planed siding; 2,600 ft. planed flooring; 2,900 shingles; 200 ft. water table; 47 ps. joist, 2x10 18s; 250 ft. moulding for outside; 60 ft. of cresting; 150 ft. corner boards; 650 yds. of lath and plaster; 8 double windows, complete; 2 sets double doors and 2 single complete; 300 ft. of 10-in. base; pews extra; 2,000 brick for chimneys.

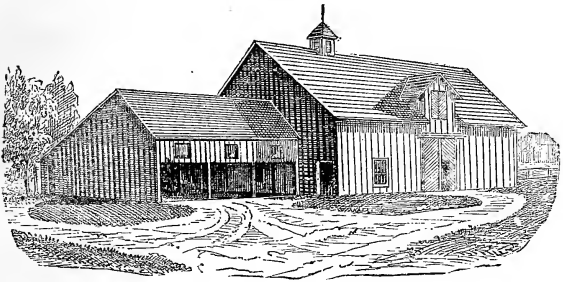


Design 23.

Almost every country church is disfigured by stoves and stove-pipes in the audience room, and the reason is that the congregation is unable to afford the expense of purchasing and keeping a furnace. Small churches can be heated more economically than by the ordinary method, as follows:

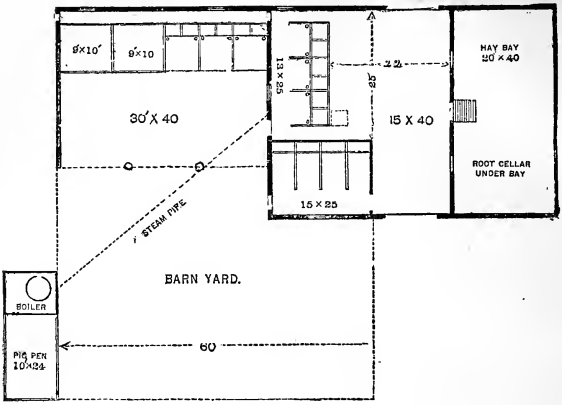
Procure a common, large box stove of a size to burn cordwood without sawing, and fitted with a good drum. Place it in the basement, and inclose it in a brick chamber, connected by a cold air shaft with the outside, and by a flue and register with the room above. Let the front of the stove appear on the outside of the chamber, and let the flues and pipe be large. This improvised furnace will heat the house more uniformly than stoves above, and will avoid the inconvenience occasioned by them, and the expense of preparing the wood.

DESIGN 24.



Material Required for Design 24.

5 trusses; in each, 1 ps. 10x10 40, 1 ps. 10x10 20, 2 ps. 10x10 14s, 2 ps. 6x10 13s, 2 rods 1½ in. o iron 11 ft. long, 2 bolts 1 in. o iron 2.3 ft. long, with heads. nuts, washers, and 3 in. of thread; 16 ps. 6x8 14s for purlins; 56 ps. 2x6 32s (made by spiking 16s together), 12 ps. 2x4 10s (over doorway), for rafters; 58 lineal ft. 2x6 for ridge pole; 14 ps. 10x10 16s for posts; 10 ps. 8x8 12s for braces on bents, 28 ps. 6x8 8s for braces on sides; 16 ps. 4x6 14s, 12 ps. 4x6 13s for stringers; 100 ps. 2x10 14s joists for upper floor, 168 ps. 2x12 14s joists for main floor; 310 lineal ft. 10x10 for sills; 456 ps. 1x6 16s, 48 ps. 1x6 20s for siding (if this siding is matched, add 1 5 and leave out the battens); 456 ps. 1x3 16s, 48 1x3 20s for battens; 3,750 sq. ft. 38,000 A No. 1 sawed shingles: 400 superficial ft. 4x4 oak for stall floors; 2,200 superficial ft. 2-in. plank for main floor; 2,200 superficial ft. 1¼-in. flooring for upper floor; 500 superficial ft. 2-in. plank for stall partitions; 900 lineal ft 3x3 in. for bridging; 750 sq. ft. 1x6 in. for ceiling for stables; 450 sq. ft. 1x6 in. for ventilator shaft; add about 100 ft. 1x6 for waste, etc. 4 large doors, 6x10 to slide on sheaves; frame of doors, 3x3 in. stuff mortised, covered with 1x3 in. matched stuff; small door cut in two of them on hinges; doors outside to stables, 3-6x6 ft. made same way but lighter; 2 light batten doors inside, 2-10x6-10; 2 windows, 6-light, 12x14; one flight stairs, 3 strings, 26 steps.



DESIGN 24.

Material Required for Shed.

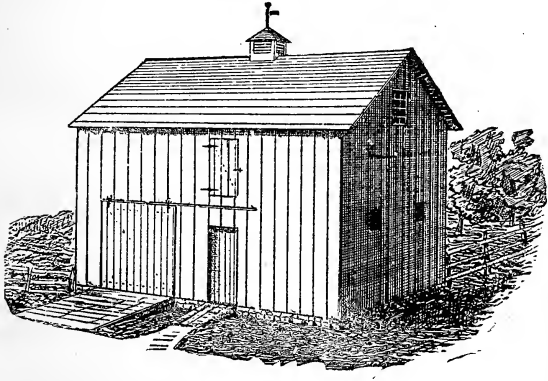
5 ps. 8x8 12s, 4 ps 6x8 8s, 1 ps. 8x8 16s for posts; 120 lineal ft. 6x8 for plates and strings; 70 lineal ft. 8x8 for sills; 20 ps. 2x6 24s, 20 ps. 2x6 16s for rafters; 40 lineal ft. 4x6 in. under rafters; 16 ps. 4x4 16s for braces; 900 sq. ft. edged siding, 450 sq. ft. 1x3 in. battens (add 1-5 if matched); 1,600 sq. ft. of roofing; 16,000 shingles; 570 superficial ft. 2-in. stuff for stall partitions; 480 superficial ft. 2-in. stuff for floors; 29 cord stone masonry under barn and shed.

This plan is taken from "Barn Plans and Outbuildings," published by the Orange Judd Company and is a complete and convenient design. The accompanying bill of material includes all that is necessary to put it up in the best and most scientific manner, but can be cheapened in some particulars as required. The size of the main part is 40x55 feet. The center through, from side to side, is occupied by the 15-ft. barn floor. The 20-ft. space on the right is occupied by the haymow, with a roct cellar under it. On the left are the stables. The horse stalls occupy a space of 15x20 feet (instead of 25 as given in the plan), and the cattle stalls, 12x25, leaving a space in front of them, to the line of the floor, of seven feet, which affords room for hay cutter, feed boxes, etc. There is a tight ceiling of matched boards over the stable, at a height of eight feet. On the straining beams of the roof is laid a substantial tight floor, which is the granary floor. It may extend the whole length of the barn, or only over the stables and threshing-floor. The small gable in the roof should have a strong beam with tackle projecting from over the door, and grain can be hoisted by

horse power from the outside. There is also a trap-door over the threshing-floor for the same purpose. Corn can be spread on this floor, and will cure much more quickly than if stored in cribs, and, as well as grain, will be out of the reach of rats and other vermin. The ventilating shaft connects this floor with the stables, and it is reached by a stairway from the floor over the stables. On the lower floor a passage way, behind the cattle stalls, connects with the stalls and loose boxes in the shed. Animals will not suffer if the front of the shed is open, but if so desired it can be closed by boarding and large doors.

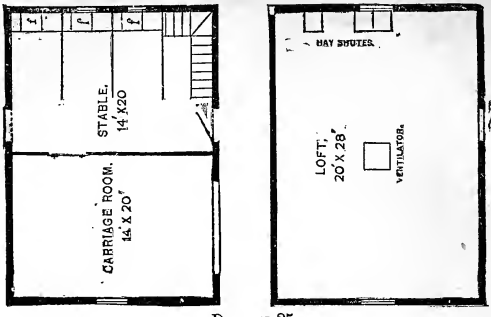
The material for the pig-pen is not included in the schedule. The boiler room is placed at this distance from the barn to insure against fire, but the barn-yard and pens can be arranged as best suits the builder.

Design 25.



Material Required for Design 25.

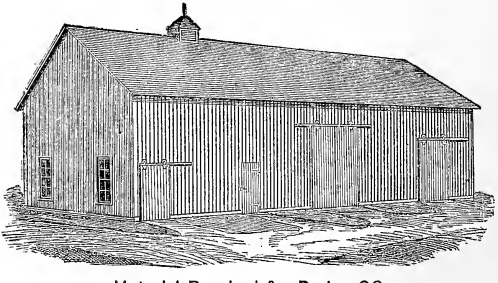
2 ps. 6x8 28s, and 3 ps. 6x8 20s for sills; 2 ps. 6x6 28s, and 3 ps. 6x6 20s for plates; 6 ps. 6x6 16s for posts; 2 ps. 4x6 28s. and 2 ps. 4x6 20s for girths; 56 ps. 2x8 14s for joists; 14 ps. 2x4 10s for partition; 20 ps. 2x6 14s for rafters; 1,625 ft. dressed dimension boards for siding; 140 ft. matched flooring for doors; 700 ft. common boards for roofing; 8,000 shingles; 1,120 ft. 2-in. 2x12s; 650 ft. matched dimension boards for floor of loft; 180 ft. matched dimension boards for partition; 400 ft. 3-in. O. G. battens; 4 ps. 4x4 16s for braces; 200 ft. 2x12 for mangers; 240 ft. common boards for stalls; 6 ps. 2x6 10s for stalls.



DESIGN 25.

DESIGN 26.

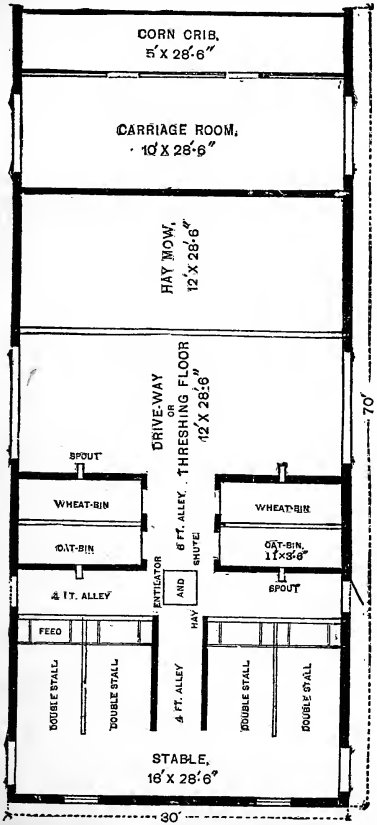
Furnished by F. Huggins, Carthage, Mo.



Material Required for Design 26.

200 lineal ft. 8x10 for main sills; 150 lineal ft. 8x8 for cross sills; 150 lineal ft. 6x6 for cross girths; 16 ps. 8x8 16s for posts; 200 lineal ft. 6x8s for plates; 200 lineal ft. 6x8s for girths; 52 ps. 2x4 10s for studs for bins, stables, etc.; 20 ps. 2x4 12s for studs between carriage room and mow; 20 ps. 2x6 12s for studs between carriage room and corn crib; 20 ps. 2x6 16s for studs for end of corn crib; 24 ps. 2x8 16s for floor joists for carriage room and corn crib; 24 ps. 2x8 12s for floor joists for drive-way; 24 ps. 2x8 8s (16s) for floor joists for bins; 24 ps. 2x8 20s for floor joists for stable; 2 ps. 4x4 16s for stringer under stable; 2,800 ft. 2x8 joists under floor of loft, which is over stable. bins. carriage room and corn crib; 72 ps. 2x6 22s (or 20s) for rafters; 36 ps. 2x4 12s for collar beams; 3,200 ft. dressed dimension boards for siding; 800 ft. 3-in. O. G. battens; 540 ft. flooring for doors; 2,500 ft. common boards for roofing; 30,000 shingles; 3,000 ft. 2-in. plank; 1,150 ft. matched dimension boards for floor of loft;

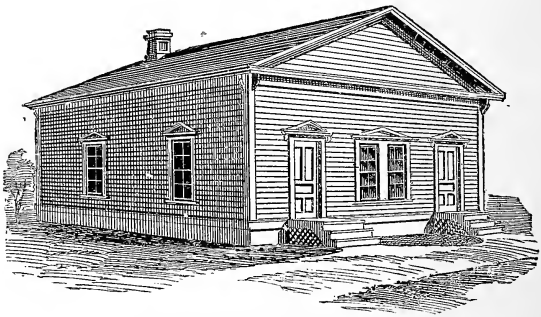
600 ft. matched dimension boards for bins; 250 ft. 1½-in. plank for mangers, etc.; 360 ft. common boards for partition between carriage room and hay mow; 270 ft. 3-in. battens between carriage room and crib; 2 ps. 2x4 16s for ladder posts in front of mow; 136 lineal ft. 4x4s for braces; 125 ft. dressed dimension boards for ventilator shaft; 2 windows, 8-light, 8x12; 2 cellar sash, 3-light, 10x12, over small doors (not indicated in cuts.



This plan is of a barn, complete and convenient in its arrangements, but the size of which can be varied to suit the requirements of the farmer building it. The roof is built one-half pitch, thus obtaining a large amount of room in the loft, and the collar beams are put only five feet below the ridge for the same purpose, and to insure strength the rafters are made of 2x6 stuff, and should be well bridged. The five cross sills are under the five main divisions of the barn, and the long joists under the stable, reaching from the bins to the end of the barn, are to be supported by a 4x4, resting on posts. The ventilating shaft should be three feet square, made of dimension boards with the dressed sides turned inward, and with openings at different heights for conducting hay or straw to the stable. This barn can be shortened by omitting either the corn crib, carriage room or hay-mow; if all are left out the drive-way could be used as a mow, and filled from the outside, thus making a fine 30x40 feet barn. The siding on the crib end should be laid horizontally, and each board given a slant from the top edge down and outward, thus protecting the corn from rain, and giving an aperture an inch wide for ventilation.

DESIGN 27.

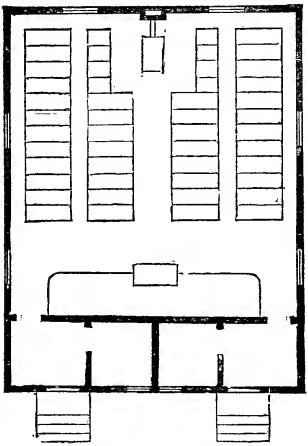
Country School House.



Material Required for Design 27.

164 lineal ft. 6x8 sills; 4 ps. 6x6 16s for corner posts; 56 ps. 2x10 14s for joists; 112 ps. 2x6 16s for studs; 28 ps. 2x6 28s for ceiling joists; 56 ps. 2x6 18s for rafters; 72 lineal ft. 2x4s for plates; 180 lineal ft. 1x3 for bridging, etc.; 3,292 ft. sheathing; 2,500 ft. siding; 13,000 shingles; 1,125 ft. flooring; 800 ft. select; 128 ft. moulding; 6 windows, 12-light, 12x22; 2

windows, 8-light, 10x22 for double window; 2 doors, 3x8, 1¾ in.; 4 doors, 2-8x7-6, 1¾ in.; 750 brick for chimney; 2,050 yds plastering. Outside dimensions, 28x36 ft.; roof, ¼ pitch; vestibules, 6x7; cloak rooms, 6x6.



DESIGN 27.

HINTS TO BUILDERS.

STRENGTH OF BUILDINGS.—THE "NEBRASKA" SILL.

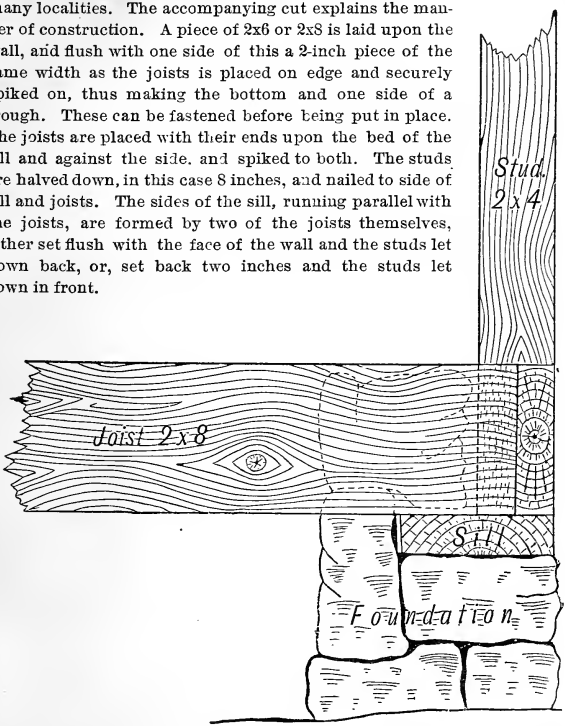
With the increasing prevalence of tornadoes in the West it becomes the duty of carpenters and builders to construct buildings with reference to such unusual strains, and especially should this be done when it involves no additional expense.

The "Nebraska sill" thoroughly ballasts the frame, where a stone foundation is used; but if the building is set on posts they should be securely anchored at a depth of from 4 to 6 feet, and the sills bolted or spiked on. Sheathing put on diagonally acts as a brace over the whole surface, and requires no more lumber than if put on horizontally. It is well to run the sheathing from each side up parallel with the rafters, if at the gable ends, and at a similar angle at the sides. Roofing boards can be put on in the same manner. Studs can be allowed to project above the plates and the rafters spiked to the sides of studs. Partitions should be braced with waste stuff, and in such ways a building can be so strengthened that it can be rolled over and over without coming to pieces, and the extra cost will simply consist in a few hours extra labor.

Many carpenters do not stop to consider how the most strength can be obtained with given materials, but do everything in the manner that first occurs to them, or that will save a little labor. Thus a carpenter ordered 2x8 18s for the floor joists in a 12x18 room. When asked why he did not place them across the room, he replied that every carpenter would order 18s, as it would save framing. A little knowledge of the strength of materials would have told him that a floor laid as he proposed would support less than one-half the weight that the 12 feet joists would sustain, and the amount of material would be the same. In many cases, also, the desire to build as cheaply as possible leads the carpenter to use material of smaller dimensions than are necessary to give the required strength, and so roofs are often inadequate to support more than their own weight, and ceilings sink, cracking and disfiguring the walls.

That all carpenters are so careless and regardless of true principles of construction, is not true, but there are too many, as is shown by the immense number of poorly constructed houses whose floors are sunken and walls twisted. A cheap house need not be a weak one.

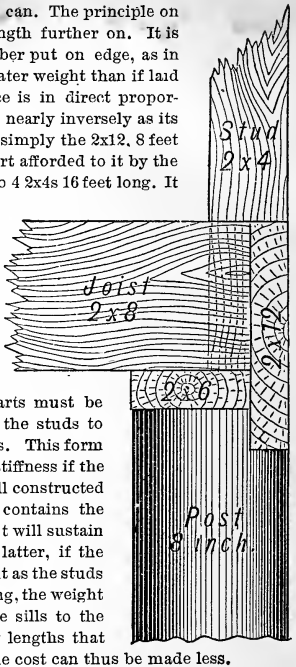
In some parts of the West and especially in Nebraska a framed sill is in use, which combines qualities that will make it of service to builders in many localities. The accompanying cut explains the manner of construction. A piece of 2x6 or 2x8 is laid upon the wall, and flush with one side of this a 2-inch piece of the same width as the joists is placed on edge and securely spiked on, thus making the bottom and one side of a trough. These can be fastened before being put in place. The joists are placed with their ends upon the bed of the sill and against the side, and spiked to both. The studs are halved down, in this case 8 inches, and nailed to side of sill and joists. The sides of the sill, running parallel with the joists, are formed by two of the joists themselves, either set flush with the face of the wall and the studs let down back, or, set back two inches and the studs let down in front.



When the frame is finished, and before the floor is laid the wall is built up behind and over the sill; thus holding all in place, guarding against wind, as the wall must be torn up before the building will go; and also, incidentally, against rats and other vermin. It will be found fully as strong and much cheaper than timber.

If posts are used for the foundation a modification of this arrangement will prove equally serviceable. The following diagram illustrates the

difference more plainly than words can. The principle on which it depends is explained at length further on. It is well known that a thin piece of timber put on edge, as in joists, etc., will support a much greater weight than if laid on its side. The strength of a piece is in direct proportion to the square of its depth and nearly inversely as its length. Thus it will be found that simply the 2x12, 8 feet long, without considering the support afforded to it by the walls, would have a strength equal to 4 2x4s 16 feet long. It might be objected that the joists would not rest on the 2x12 but on the 2x6. This is partly true, but the joists are spiked to the 2x12, and are nailed to the studs, which rest on the sill, thus binding the whole together. Particular care must be taken to spike the 2x12 side of the sill to the 2x4 or 2x6 base at short intervals. All the parts must be well nailed together, and especially the studs to the joists, and the sills to the posts. This form will have abundant strength and stiffness if the posts are not over 8 feet apart. A sill constructed in this way, of these dimensions, contains the same number of feet as a 6x6 sill, but will sustain a weight a third greater than the latter, if the weights are placed at the centers, but as the studs are fastened together by the sheathing, the weight will be partly transferred from the sills to the posts. It can also be made of any lengths that will reach from post to post, and the cost can thus be made less.



STRENGTH OF MATERIALS.

Materials are subjected in machinery and buildings to one or more of four different strains affecting their durability, viz.:

1st.—Tension, or a force which tends to pull apart the fibres or particles of a substance, such a force is exerted in tie beams, suspension rods, ropes, etc.

2d.—Compression, or a force tending to crush the substance, as in columns, braces, arches, etc.

3d.—Transverse or lateral strains, tending to break apart the fibers, as in joists, girders, etc.

4th.—Torsion, or twisting, as in shafts, screws, etc.

TENSION.

That property of materials which enables them to resist tension is called their cohesive force. The following table gives the force necessary to pull apart a rod of one square inch section of the various materials given. These results have been obtained from numerous experiments.

METALS.

	POUNDS.		POUNDS.
Brass	35,600	Lead, cast	880
Copper, cast	22,5.0	Lead, milled	3,320
Copper, wire	30,900	Plat num wire	53,000
Iron, cast	20,000	Silver, cast	41,000
Iron, cast. English	52,000	Silver, wire	38,250
Iron, wrought	60,000	Steel, soft	120,000
Iron, wrought, Swedish	72,000	Steel, fine	125,000
Iron, wrought, English	56,000	Steel, razor, tempered	150,000
Iron, wire	85,700	Tin, cast block	50,000
	113,000	Zinc, cast	2,600
Iron, medium bar	60,000	Zinc, sheet	16,000
Iron, inferior bar	30,000		

WOODS.

	POUNDS.		POUNDS.
Ash, white, seasoned	14,000	Mahogany	21,800
Ash, red, seasoned	17,800	Mahogany, Spanish	12,000
Birch	15,500	Maple	10,500
Beech	11,000	Oak, white	15,000
Cedar	11,000	Oak, English	10,000
Chestnut, sweet	10,000	Oak, seasoned	13,500
Cypress	6,000	Pine, white	10,000
Elm	13,000	Pine, pitch	12,000
Elm, rock	16,000	Pine, Norway	13,000
Fir, American	8 500	Poplar	7,000
Lance wood	24 000	Sycamore	13,000
Lignum Vitæ	12,000	Walnut	17,000
Locust	20,000	Willow	13,000

MISCELLANEOUS.

	POUNDS.		POUNDS.
Brick	290	Marble	9,000
Glass, plate	9,400	Morter, 20 years old	52
Hemp, fibres glued together	92,000	Slate	12,000
Hemp, rope	19,600	Stone, fine grain	200
Ivory	16,000	Whalebone	7,600

In practice one fourth of the above weights is taken as the strength of the material.

COMPRESSION.

The following table gives the number of pounds resistance a square inch

of the given materials will oppose to compression without permanent alteration.

	POUNDS.		POUNDS.
Ash	3,540	Lead, cast	1,500
Beech	2,360	Mahogany	3,800
Brass	6,700	Oak, English	3,950
Brick	560	Pine, American yellow	3,900
Cast iron	15,300	Steel	45,000
Elm	3,240	Stone, Portland	3,700
Granite, Aberdeen	10,900	Tin, cast	2,880
Gun metal, cast	10,000	Whalebone	5,600
Iron, malleable	17,800	Zinc, cast	5,700

As in tension, material should never be loaded with more than one-fourth of its utmost strength.

TRANSVERSE STRAINS.

Many experiments have been made to determine the breaking strain of different building materials. The average results are given in the following table, the pieces used in the experiment being uniform rods one foot long, and with ends one inch square, supported horizontally by standards at each end, and the weight applied perpendicularly at the center.

	POUNDS.		POUNDS.
Ash	635	Iron, cast (extreme weight, with-	
Beech	677	out making permanent change)	850
Birch	517	Oak	660
Chestnut	450	Poplar, Lombard	327
Elm	540	Spruce, American	570
Hard pine, American	658	Walnut, green	487

As this table expresses the breaking weight of each piece it would not be safe to permanently load them with more than one-fourth the weight given in the table.

Experiments have shown, and mathematical calculations demonstrated, that the strength of beams and girders varies, inversely as their length, and directly as their width, and the squares of their depths. Thus, a beam 8 feet long will be only one-half as strong as one of the same breadth and depth, and 4 feet long; and the latter will be 4 times as strong as one of the same breadth and depth, and 16 feet long. Two beams of the same length and depth will sustain a weight just in proportion to their width; by doubling the width the strength is doubled. If two pieces have the same length and breadth their strength will be as the square of their depths. If one has twice the depth of the other, it will sustain a weight four times as great. A 2x12 8 will bear four times the weight that a 2x6 8 will, the 2x6 8 will bear one-third the weight that a 6x6 8 will sustain. Therefore, a 2x12 placed on edge will bear a weight placed on its center

one-third greater than can be borne by a 6x6 of the same length. The above is not strictly true in regard to lengths, as the strength appears to diminish in a ratio greater than the inverse proportion of the length; caused, probably, by the tendency to bulge and twist in long pieces of timber. This error is provided for in the following *rule*:—To find from the foregoing table the breaking weight of any piece of timber, the length, breadth and thickness being given: Divide the breaking weight given in the table by the length in feet; subtract 10 from the quotient; multiply the remainder by the breadth in inches and that product by the square of the depth in inches

EXAMPLE:—Required the breaking weight of a hard pine scantling 2in. ×12in. ×10 feet supported at ends.—658÷10=65, 65—10=55, 55×2×144= 15,840=breaking weight, 15,840×4=3,960=greatest weight it should be required to support permanently.

EXAMPLE:—Required the breaking weight of a hard pine sill 6in. ×6in. ×10 feet, supported at the ends; 658÷10=65, 65—10=55, 55×6×36=10,880 =breaking weight, 10,880÷4=2,720=greatest weight the sill should be required to bear.

The following dimensions, taken from the Liverpool Building Act, may be considered as standard sizes of joists for ordinary buildings. The distances between centers being one foot, joists in floors, clear bearing.

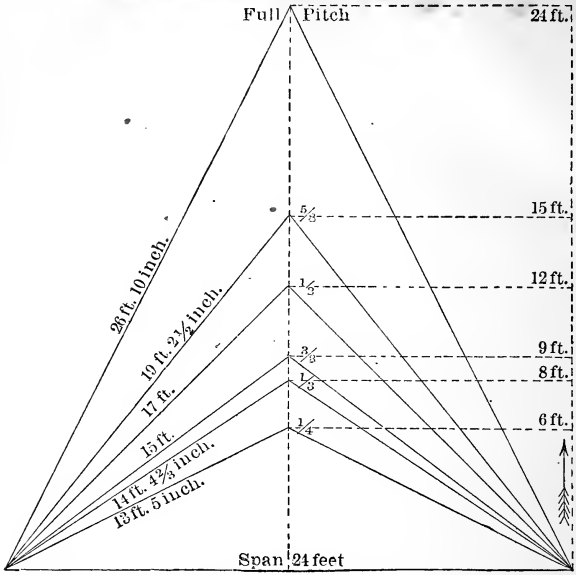
Exceeding	7	and not exceeding	10	ft.	should be	not less than	6x2 in.
"	10	"	12	"	"	"	6x2½ "
"	12	"	14½	"	"	"	7x2½ "
"	14½	"	16	"	"	"	8x2½ "
"	16	"	18	"	"	"	9x2¾ "
"	13	"	20	"	"	"	10x2¾ "
"	20	"	22	"	"	"	11x3 "
"	22	"	24	"	"	"	12x3 "

As timber does not come in fractions of inches, when a greater width or depth is used than that indicated the distance between centers can be increased proportionally.

TORSION is very seldom to be considered in calculating the strains to which building material is subjected, and its discussion will, therefore, be omitted from this book. Its province is in machinery, and its effect on shafts, etc., must be considered, and made the subject of special study, by the mechanical engineer.

ROOF ELEVATIONS.

By the "pitch" of a roof is meant the relation which the height of the ridge above the level of the roof-plates bears to the span, or the distance between the studs on which the roof rests. Thus, in the following diagram, with a span of 24 feet, and with a roof made one-fourth pitch, the ridge is 6 feet above the plates, with one-third pitch, 8 feet above, etc.



The length of rafters for the most common pitches can be found as follows from any given span:

If ¼	Pitch	multiply	Span	by	.559,	or 7-11 nearly.
" ⅓	"	"	"	.6+,	" 3-5	"
" ⅜	"	"	"	.625,	" ⅝	
" ½	"	"	"	.71+,	" 7-10	"
" ⅝	"	"	"	.8+,	" 4-5	"
" Full	"	"	"	1.12,	" 1⅛	"

To lengths thus obtained must be added amount of projection of rafters at the eaves.

As rafters must be purchased of even lengths, a few inches more or less on their lengths will make a difference tn the pitch so slight that it cannot be detected by the eye.

EXAMPLE:—To determine the length of rafters for a roof constructed one-half pitch, with a span of 24 feet—24×.71=17.04; or, practically, just 17 feet as in cut. A projection of 1 foot for eaves makes the length to be purchased 18 feet.

HEATING AND VENTILATION.

There is no one subject of more vital importance to the public and particularly to those people who own homes, than that embraced in the above caption. In connection with the foregoing designs, and hints to builders, a brief chapter under this head is not out of place, and may be of no little value to the reader. By the term "builder" as used herein is meant more than is ordinarily included in the mechanical designation, "carpenter and builder"—*i. e.* one whose avocation it is to design and construct buildings. We mean all those who build for themselves homes in which their days are to be spent, and in the construction of which certainly no pains should be spared to secure pleasure, comfort and health. Toward the last and most important of these the following remarks are directed.

As in almost everything we do, there is a right way and a wrong way to build a house, which assertion is forcibly illustrated in the two diagrams which follow. If rooms be constructed the same as boxes, closed tightly at top and bottom with only the ordinary doors and windows for openings, they must necessarily be unhealthy, as no circulation of the air can take place. The two greatest and most indispensible agents to health furnished by nature are fresh air and sunshine. To exclude either or both is to invite disease and death. Unless some means are provided for the ingress and egress of pure air, by which that in a room is constantly changing, it becomes at once impure, and the more persons there are in the room the worse this condition will be. The cold, dead and impure air falls to the floor, and is a constant menace to the health and lives of children whose time is principally spent there. This is probably the least understood of all the evils that beset the path of infancy and early childhood. Not only does the little one live in the coldest air of the room, but the foulest. Anyone knows that carbonic acid gas is a deadly poison, and anyone also ought to know that it is constantly thrown off from the human lungs in the process of breathing. Being heavier than air it falls to the floor and there remains and accumulates until some means of displacing it by pure air are used. Some one has very truly said, "our breath is our greatest enemy." The stifling atmosphere of any unventilated room in which a crowd of persons are gathered amply proves this assertion, and accounts for the many instances where ladies or anyone physically weak are known to be carried out of such crowds in a fainting condition. To attain the highest perfection in ventilation the air nearest the floors of a room should be warmest, growing gradually cooler nearer the ceiling. This keeps the feet warm and the head cool. Under the old-fashioned way of building houses with wide, open fireplaces, this condition was partially secured by reason of the draft from

the chimney which necessarily exhausted more or less air from the bottom of the room. With the modern method, however, of building almost an air-tight house, and heating it by stoves, the question of properly supplying the rooms with fresh air becomes of vital importance.

The best time to consider all these questions is upon building a new house. Then, the expense of complying with these reasonable laws of nature and health is little or nothing, while to change over an air-tight box into a healthy and comfortable habitation would require quite an outlay. In the diagrams which follow Fig. 1 represents the common form of balloon-frame house, in which, as usually constructed, the air is not only bad, but the heat is wrongly applied, as the following explanation will show:

The usual sill is simply a 2x8 plank upon which rest the studding of the outer walls and also the first story joists which are spiked to the studding. Then come the second story and attic joists, both nailed to the studding. A glance at the diagram shows that the floor, laid up to the inside of the studding, is joined at that point with the plastering upon the walls which continues up to and over the ceiling and down to the floor again on the other side. Upon the outside of the studding, of course, come the sheathing and siding, leaving an open space all around each room between this and the plastering. Each room is a box, the bottom of which is one-inch flooring, while the sides and top are one-half or three-quarter inch plastering. Tens of thousands of houses are standing to-day all over this country built in this way, in which a rat or mouse may start from below the first floor and make the whole circuit, going up one side between the studding to the attic, over and down the other side without interruption.

The moment a higher temperature is created in any room the walls of plaster begin to radiate heat into the spaces mentioned, and the air within becomes rarified and at once moves to the right or left and crawls up the walls to the attic. To take its place the cold air in the upper part falls down under the floors. If the temperature in the attic be zero, the air underneath each floor, also cooled by the frost that penetrates the siding, must be very nearly the same. Thus it appears that had it been the design of the builder to make the floors cold, he could not have hit upon a device more certain to produce that result.

The arrows in the diagram Fig. 1 indicate the way the air will circulate through it, may be from right to left or the reverse, as influenced by external currents. Heat this house as you may by furnace, steam coil or common stove, the upper part of each room must be hot while the floor will be cold. Any person who has not actually tested it with the mercury will be astonished at the results of a trial. Cut a hole in the floor of either story and drop a thermometer into it any winter day, and then

try it six or eight feet above the floor. The test has frequently been made in all kinds of houses. Sometimes when the thermometer marked 75° Fah. six feet above the floor it would go to 45° or 40° below the floor. This is all wrong and unquestionably kills more children than any other known cause.

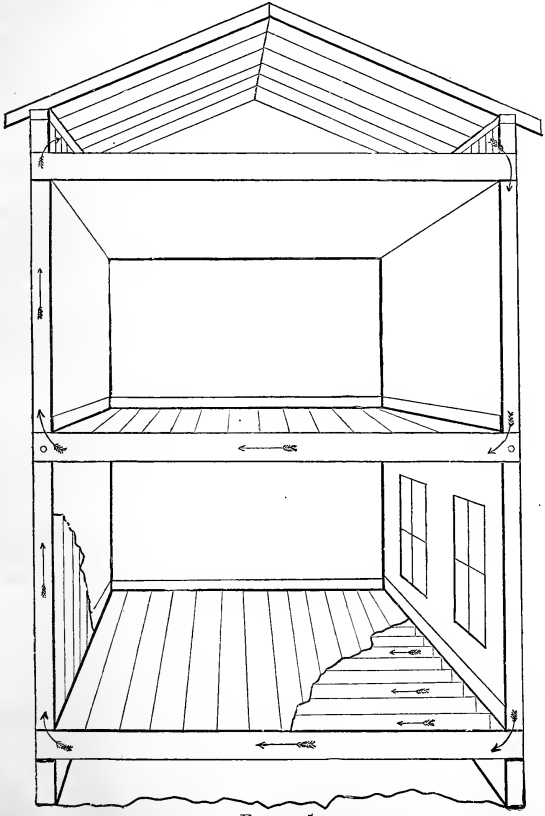


FIGURE 1.

The following drawing Figure. 2 is designed to illustrate how a dwelling house may be built so as not only to insure a full supply of fresh air, but so that the floors in cold weather shall always be the warmest part of the room. On examination of the cut it will be seen that under the main and second floors there are three sets of timbers, in place of one as usual; the regular joist, and above and below it small joists or strips, that are crosswise of the large ones, the floor resting on the upper strips. and the

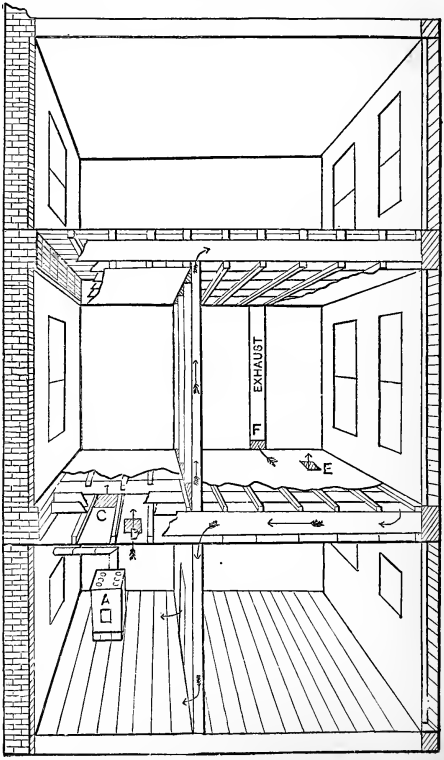


FIGURE 2.

plastering on the lower ones. By this device we have an opening between the floor and the regular joist above, and below the joist an opening between it and the plastering. This provides for the circulation of air between, over and under the joist, so that it may flow freely in any direction.

The right side of the building is represented as being cut down between two pieces of studding so as to show the inside of the clapboards or sheathing, and the space between the ceiling and each floor just above. Observe that at this point it is shown as boxed between the joist and studding, and filled in solid with cheap mortar or cement, so as to completely cut off all flow of air from under the floor out to the siding, or *vice versa*, and from one story to another. The left hand of the drawing shows a brick wall, with the usual space between it and the plastering, although these remarks apply as well to frame as to brick buildings. This appears also cut off by a projection or offset in the wall of four inches or more, which is nicely plastered between the joist and strips, and must extend clear around the house, *i. e.*, on the inside of the outer wall. The floor is then laid to lap over this on the top, and the plastering to lap under it on the bottom. This may be called a low room, say 12, 14 or 16 inches high that is tight all around.

It will at once be understood that if warm air were let into it, but very little fuel would be required to heat it to the temperature of an ordinary room that may be as many feet high as this is inches.

Underneath the hall, in the cellar, the reader will note a square box marked A; this represents the heater (which may be in any form) and is supposed to be supplied with fresh air in the usual way. But in place of tin pipes leading out to each room, the warm air is discharged into this room, or hall, and must at once take its place at the ceiling. The joist and timbers above this being shown as broken away, the openings C and D in the ceiling of this room are visible. The warm air must then flow through these up under the floor, and then spread out in all directions, the warmest hugging the floor, displacing the coldest, which must fall below the joist. If there were no openings or registers in the floor, and the partition wall on the right of the heater was left open as shown, and an open base was used inside the furnace room, it will be seen that the coldest air under the floor must then fall down this partition and into the heating room, as indicated by the arrows. This whole space, *i. e.*, the furnace room and space under the floor, becomes practically an enlarged section of the fresh air duct, and the air in it is thus shown to circulate from the heater up under the floor and back, exactly as it does around any heater in a room heated by direct radiation. In this way the entire floor and floor timbers may be heated to any degree desired, even if the windows or doors of the room above were open.

Registers, as shown at E, are placed in the floor, at any point most

convenient, and when the air above, or in the room proper, is to be heated, the register is opened and the air flows in exactly as if discharged from the ordinary furnace pipe, with this difference, it is never hot, only warm, say 75, 80 or 90°, the same as the actual temperature of the timbers. From the rooms no air ever returns to the heaters, but it is exhausted above the floor, as indicated at the exhaust chimney, F on the bottom—exhaust plan. A second or third floor may be heated in exactly the same way by allowing the warm air to pass up any partition wall, as indicated in the plan by the open partition on the main floor. Dampers are provided in these partitions so that the flow of air can be shut off or turned on at pleasure.

Of course any arrangement of rooms may be used and any style of architecture, this plan being alike adapted to all.

Those interested will notice the philosophical difference of the effect of heat or cold as applied to a structure on this plan and one built as in Fig. 1.

In that, the heat first warms the ceilings and walls, radiates into the spaces above and behind the plastering, and the cold air absorbs it, and at once a current of air is caused to move around and around the rooms, carrying off a majority of the heat generated by the fuel and ever leaving the coldest air at the floor. In Fig. 2, the floors must be first warmed and the ceilings, being warmed by the air from under the floors, cannot be as warm, because that air cannot heat another thing warmer than itself. Again, the spaces on the walls behind the plastering being closed top and bottom, now become dead air spaces, and serve as a cushion or non-conducting wall, tending to prevent the escape of heat, exactly opposite to the other plan.

The system of floor warming and ventilation, above described and shown in Fig. 2, is patented by Mr. B. R. Hawley, of Chicago, and has been introduced into a number of dwellings and business blocks in that city, as well as in Kansas City, Mo., with very satisfactory results. In constructing a new building, it is comparatively inexpensive, and for any ordinary house in the country, it is not probable that the patentee's charges would amount to very much.

Whether this particular device be used or not, builders cannot be too strongly urged to give the subject of ventilation more thought than has been bestowed upon it in years past, and whether the building be a dwelling worth $10,000, or a cot costing less than a tenth of that sum, to provide some natural means for admitting the pure air and exhausting the foul. The life of an occupant is just as precious in the cot as the castle, and if only a very little common sense is exercised, the ventilation may be as perfect in one case as the other. The use of open fire-places should be encouraged always. Besides being infinitely more cheerful than the

stove, or that other barbarous contrivance, the hot-air furnace, they are great natural aids to ventilation, the heated draft up the chimney exhausting the air from the bottom of the room, and drawing the warmer and purer air downward. In the preceding sentence the word "barbarous," in relation to furnaces, was used advisedly. It is fast becoming known to those who make the subject a study that furnace heat is the most injurious to health of any that can be obtained. It consists of a volume of hot-air full of minute particles of dust, projected into a room in such a manner as to go straight to the ceiling, whence it only settles down slowly, as it is compelled to by the pressure of the quantity which comes steadily from the register. The floor of such a room is always cold, and the occupants experience the unnatural and injurious effect of cold feet and hot heads. If any parent will hold a thermometer on the floor of a furnace-heated room, then five feet above, and finally at the ceiling, he or she will never thereafter suffer a child to spend its time on the carpet. The only way in which furnace heat can be rendered even tolerable is by the use of the expensive Ruttan system, which consists of a double set of pipes and registers; one to deliver the hot air into the room, in the ordinary way, and the other to take the cold air out by way of the chimney, into which the extra set of pipes conduct it.

The writer has seen the following simple and inexpensive arrangement ventilate a room quite thoroughly: From the elbow of the pipe to an ordinary kitchen stove, a smaller pipe was carried down to within three or four inches of the floor. This in no way interfered with the draft to the stove, and served as an excellent exhaust for the air at the bottom of the room; the greater the heat and current of air up the chimney the more thoroughly would the exhaust pipe do its work. The entire absence of odors that naturally arise from cooking proved that it was capable of changing the air of the room often enough to keep it in at least a reasonably healthy condition. The same device, which anyone can attach to any ordinary wood or coal stove, will have the same effect upon any room. The greatest nonsense in the world is the idea of a base heating stove, *i. e.*, one that will radiate heat laterally from its base near the floor, sufficient to warm the lower stratum of air. No heating apparatus can be made to do that unless means are provided for expelling the stagnant air always found on the bottom of an illy-ventilated room. Another thing: air cannot be exhausted from the bottom of a room satisfactorily unless heat is in some way applied to the ventilating shaft. If a hole is made near the floor in the flue of a chimney that is in constant use, the ventilation will be successful. If the heat is shut off, however, the column of air in the flue, upon getting cold, will be liable to remain stationary, if, indeed, it does not reverse its motion and flow into, instead of out of, the room. A very little practical study of one of the simplest of nature's

laws will not only add comfort to the home, but guarantee health and longer life to its inmates. It is a fact both well and widely known, that a great many persons become ill without knowing the nature of the disease, and even the skill of the physician is baffled. There is no more prolific cause of such maladies than living, and especially sleeping, in poorly ventilated rooms. Pure air is just as essential to life and health as wholesome food. No one would recommend decayed vegetables or fruit as a healthy diet; yet people live day after day breathing an atmosphere that is just as unwholesome and equally injurious to health.

RETAILER'S READY RECKONER.

The tables on the following pages will be found useful to retail lumbermen. They are prepared for the purpose of enabling the ready ascertaining of the number of feet and fractions of a foot contained in a given number of pieces of any size of timber ordinarily kept in stock, from twelve to thirty feet in length, and from 1x12 to 12x12 in size. The top line in each table shows the exact fractions over a full foot in each size. In all others, fractions under one-half are excluded, and over one-half added. To ascertain the number of feet in a given number of pieces of any size named in the tables, find the length in the top line and the number of pieces at the left hand and trace the two lines to their junction, where the number of feet will be found. To ascertain the feet in any number of pieces not specified, add together the two or more quantities making that number. For example: To find the number of feet and fractions of a foot in twenty-five pieces of 2x4 sixteens, run down the sixteen foot column to its junction with the twenty at the left, the number found there being 240; then trace the line from five at the left hand to its junction with the sixteen foot column, obtaining as the result, 53, which added to the 240 gives 293 feet, the correct amount in twenty-five pieces of 2x4 sixteens. If greater lengths are required, double the figures in the columns which are multiples of those required. Thus: for thirty-two double sixteen; for thirty-four add the sixteen and eighteen together. This process will give all the lengths up to sixty feet.

1×8 or 2×4.

Fractions over $\frac{1}{2}$ added, others excluded.

No. Pieces	12	14	16	18	20	22	24	26	28	30
1	8	9 1/3	10 2/3	12	13 1/3	14 2/3	16	17 1/3	18 2/3	20
2	16	19	21	24	27	29	32	35	37	40
3	24	28	32	36	4	44	48	52	57	60
4	32	37	43	48	53	59	64	69	75	80
5	40	47	53	60	67	73	80	87	93	100
6	48	56	64	72	80	88	96	104	112	120
7	56	65	75	84	93	103	112	121	126	140
8	64	75	85	96	107	117	128	139	149	160
9	72	84	96	108	120	132	144	156	168	180
10	80	93	107	120	133	147	160	173	187	200
20	160	187	213	240	267	293	320	347	373	400
50	400	467	533	600	667	733	800	867	917	1000
100	800	933	1067	1200	1333	1467	1600	1733	1867	2000

1×12, 2×6 or 3×4.

Fractions over $\frac{1}{2}$ added, others excluded.

No. Pieces	12	14	16	18	20	22	24	26	28	30
1	12	14	16	18	20	22	24	26	28	30
2	24	28	32	36	40	44	48	52	56	60
3	36	42	48	54	60	66	72	78	84	90
4	48	56	64	72	80	88	96	104	112	120
5	60	70	80	90	100	110	120	130	140	150
6	72	84	96	108	120	132	144	156	168	180
7	84	98	112	126	140	154	168	182	196	210
8	96	112	128	144	160	176	192	208	224	240
9	108	126	144	162	180	198	216	234	252	270
10	120	140	160	180	200	220	240	260	280	300
20	240	280	320	360	400	440	480	520	560	600
50	600	700	800	900	1000	1100	1200	1300	1400	1500
100	1200	1400	1600	1800	2000	2200	2400	2600	2800	3000

9×16 or 12×12.

Fractions over ½ added, others excluded.

No. Pieces	12	14	16	18	20	22	24	26	28	30
1	144	168	192	216	240	264	288	312	336	360
2	288	336	384	432	480	528	576	624	672	720
3	432	504	576	648	720	792	864	936	1008	1080
4	576	672	768	864	960	1056	1152	1248	1344	1440
5	720	840	960	1080	1280	1320	1440	1560	1680	1800
6	864	1008	1152	1296	1440	1584	1728	1872	2016	2160
7	1008	1176	1344	1512	1680	1848	2016	2184	2352	2520
8	1152	1344	1536	1728	1920	2112	2304	2496	2688	2880
9	1296	1512	1728	1944	2160	2376	2592	2808	3024	3240
10	1440	1680	1920	2160	2400	2640	2880	3120	3360	3600
20	2880	3360	3840	4320	4800	5280	5760	6240	6720	7200
50	7200	8400	9600	10800	12000	13200	14400	15600	16800	18000
100	14400	16800	19200	21600	24000	26400	28800	31200	33600	36000

4×7 and 2×14.

Fractions over ½ added, others excluded.

No. Pieces	12	14	16	18	20	22	24	26	28	30
1	28	32⅔	37⅓	42	46⅔	51⅓	56	60⅔	65⅓	70
2	56	65	75	84	93	103	112	121	131	140
3	84	98	112	126	140	154	168	182	196	210
4	112	131	149	168	187	205	224	243	261	280
5	140	163	187	210	233	257	280	303	327	350
6	168	196	224	252	280	308	336	364	392	420
7	196	229	261	294	327	359	392	425	457	490
8	224	261	299	336	373	411	448	485	523	560
9	252	294	336	378	420	462	504	546	588	630
10	280	327	373	420	467	513	560	607	653	700
20	560	654	747	840	934	1027	1120	1213	1307	1400
50	1400	1632	1867	2100	2333	2567	2800	3033	3267	3500
100	2800	3267	3733	4200	4667	5133	5600	6067	6533	7000

2×12, 3×8 or 4×6.

Fractions over $\frac{1}{2}$ added, others excluded.

No. Pieces	12	14	16	18	20	22	24	26	28	30
1	24	28	32	36	40	44	48	52	56	60
2	48	56	64	72	80	88	96	104	112	120
3	72	84	96	108	120	132	144	156	168	180
4	96	112	128	144	160	176	192	208	224	240
5	120	140	160	180	200	220	240	260	280	300
6	144	168	192	216	240	264	288	312	336	360
7	168	196	224	252	280	308	336	364	392	420
8	192	224	256	288	320	352	384	416	448	480
9	216	252	288	324	360	396	432	468	504	540
10	240	280	320	360	400	440	480	520	560	600
20	480	560	640	720	800	880	960	1040	1120	1200
50	1200	1400	1600	1800	2000	2200	2400	2600	2800	3000
100	2400	2800	3200	3600	4000	4400	4800	5200	5600	6000

1×18, 2×9 or 3×6.

Fractions over $\frac{1}{2}$ added, others excluded.

No. Pieces	12	14	16	18	20	22	24	26	28	30
1	18	21	24	27	30	33	36	39	42	45
2	36	42	48	54	60	66	72	78	84	90
3	54	63	72	81	90	99	108	117	126	135
4	72	84	96	108	120	132	144	156	168	180
5	90	105	120	135	150	165	180	195	210	225
6	108	126	144	162	180	198	216	234	252	270
7	126	147	168	189	210	231	252	273	294	315
8	144	168	192	216	240	264	288	312	336	360
9	162	189	216	243	270	297	324	351	378	405
10	180	210	240	270	300	330	360	390	420	450
20	360	420	480	540	600	660	720	780	840	900
50	900	1050	1200	1350	1500	1650	1800	1950	2100	2250
100	1800	2100	2400	2700	3000	3300	3600	3900	4200	4500

1×16, 2×8 or 4×4.

Fractions over ½ added, others excluded.

No. Pieces	12	14	16	18	20	22	24	26	28	30
1	16	18⅔	21⅓	24	26⅔	29⅓	32	34⅔	37⅓	40
2	32	37	43	48	53	59	64	69	75	80
3	48	56	64	72	80	88	96	104	112	120
4	64	75	85	96	107	117	128	139	149	160
5	80	93	107	120	133	147	160	173	187	200
6	96	112	128	144	160	176	192	208	224	240
7	112	131	149	168	187	205	224	243	261	280
8	128	149	171	192	213	235	256	277	299	320
9	144	168	19-	216	240	264	288	312	336	360
10	160	187	213	240	267	293	320	347	373	400
20	320	373	427	480	533	587	640	693	747	800
50	800	933	1067	1200	1333	1467	1600	1733	1867	2000
100	1600	1867	2133	2400	2667	2933	3200	3467	3733	4000

2½×8, 2×10 or 4×5.

Fractions over ½ added, others excluded.

No. Pieces	12	14	16	18	20	22	24	26	28	30
1	20	23½	26⅔	30	33⅓	36⅔	40	43⅓	46⅔	50
2	40	47	53	60	67	73	80	87	93	100
3	60	70	80	90	100	110	120	130	140	150
4	80	93	107	120	133	147	160	173	187	200
5	100	117	133	150	167	183	200	217	233	250
6	120	140	160	180	200	220	240	260	280	300
7	140	163	187	210	233	257	280	303	327	350
8	160	187	213	240	267	293	320	347	373	400
9	180	210	240	270	300	330	360	390	420	450
10	200	233	267	300	333	367	400	433	467	500
20	400	467	533	600	667	733	800	867	933	1000
50	1000	1167	1333	1500	1667	1833	2000	2167	2333	2500
100	2000	2333	2667	3000	3333	3667	4000	4333	4667	5000

2×15, 2½×12, 3×10 or 5×6.

Fractions over ½ added, others excluded.

No. Pieces	12	14	16	18	20	22	24	26	28	30
1	30	35	40	45	50	55	60	65	70	75
2	60	70	80	90	100	110	120	130	140	150
3	90	105	120	135	150	165	180	195	210	225
4	120	140	160	180	200	220	240	260	280	300
5	150	175	200	225	250	275	300	325	350	375
6	180	210	240	270	300	330	360	390	420	450
7	210	245	280	315	350	385	420	455	490	525
8	240	280	320	360	400	440	480	520	560	600
9	270	315	360	405	450	495	540	585	630	675
10	300	350	400	450	500	550	600	650	700	750
20	600	700	800	900	1000	1100	1200	1300	1400	1500
50	1500	1750	2000	2250	2500	2750	3000	3250	3500	3750
100	3000	3500	4000	4500	5000	5500	6000	6500	7000	7500

2×16 and 4×8.

Fractions over ½ added, others excluded.

No. Pieces	12	14	16	18	20	22	24	26	28	30
1	32	37⅓	42⅔	48	53⅓	58⅔	64	69⅓	71⅔	80
2	64	75	85	96	107	117	128	139	149	160
3	96	112	128	144	160	176	192	208	224	240
4	128	149	171	192	213	235	256	277	299	320
5	160	187	213	240	267	293	320	347	373	400
6	192	224	256	288	320	352	384	416	448	480
7	224	261	299	336	373	411	448	485	523	560
8	256	299	341	384	427	469	512	555	597	640
9	288	336	384	432	480	528	576	624	672	720
10	320	373	427	480	533	587	640	693	747	800
20	640	747	853	960	1066	1173	1280	1387	1493	1600
50	1600	1867	2034	2400	2665	2933	3200	3467	3733	4000
100	3200	3734	4266	4800	5330	5867	6400	6933	7469	8000

2×18, 3×12 or 6×6.

Fractions over ½ added, others excluded.

No. Pieces	12	14	16	18	20	22	24	26	28	30
1	36	42	48	54	60	66	72	78	84	90
2	72	84	96	108	120	132	144	156	168	180
3	108	126	144	162	180	198	216	234	252	270
4	144	168	192	216	240	264	288	312	336	360
5	180	210	240	270	300	330	360	390	420	450
6	216	252	288	324	360	396	432	468	504	540
7	252	294	336	378	420	462	504	546	588	630
8	288	336	384	432	480	528	576	624	672	720
9	324	378	432	486	540	594	648	702	756	810
10	360	420	480	540	600	660	720	780	840	900
20	720	840	960	1080	1200	1320	1440	1560	1680	1800
50	1800	2100	2400	2700	3000	3300	3600	3900	4200	4500
100	3600	4200	4800	5400	6000	6600	7200	7800	8400	9000

4×12 or 6×8.

Fractions over ½ added, others excluded.

No. Pieces	12	14	16	18	20	22	24	26	28	30
1	48	56	64	72	80	88	96	104	112	120
2	96	112	128	144	160	176	192	208	224	240
3	144	168	192	216	240	264	288	312	336	360
4	192	224	256	288	320	352	384	416	448	480
5	240	280	320	360	400	440	480	520	560	600
6	288	336	384	432	480	528	576	624	672	720
7	336	392	448	504	560	616	672	728	784	840
8	384	448	512	576	640	704	768	832	896	960
9	432	504	576	648	720	792	864	936	1008	1080
10	480	560	640	720	800	880	960	1040	1120	1200
20	960	1120	1280	1440	1600	1760	1920	2080	2240	2400
50	2400	2800	3200	3600	4000	4400	4800	5200	5600	6000
100	4800	5600	6400	7200	8000	8800	9600	10400	11200	12000

10×10 or 8×12½.

Fractions over ½ added, others excluded.

Nos. Pieces	12	14	16	18	20	22	24	26	28	30
1	100	116⅔	133⅓	150	166⅔	183⅓	200	216⅔	233⅓	250
2	200	233	267	300	333	367	400	433	467	500
3	300	350	400	450	500	550	600	650	700	750
4	400	467	533	600	667	733	800	867	933	1000
5	500	583	667	750	833	917	1000	1083	1167	1250
6	600	700	800	900	1000	1100	1200	1300	1400	1500
7	700	817	933	1050	1167	1283	1400	1517	1633	1750
8	800	933	1067	1200	1333	1467	1600	1733	1867	2000
9	900	1050	1200	1350	1500	1650	1800	1950	2100	2250
10	1000	1167	1333	1500	1667	1833	2000	2167	2333	2500
20	2000	2333	2667	3000	3333	3667	4000	4333	4667	5000
50	5000	5833	6667	7500	8333	9167	10000	10833	11667	12500
100	10000	11667	13333	15000	16667	18333	20000	21667	23333	25000

10×12 or 8×15.

Fractions over ½ added, others excluded.

No. Pieces	12	14	16	18	20	22	24	26	28	30
1	120	140	160	180	200	220	240	260	280	300
2	240	280	320	360	400	440	480	520	560	600
3	360	420	480	540	600	660	720	780	840	900
4	480	560	640	720	800	880	960	1040	1120	1200
5	600	700	800	900	1000	1100	1200	1300	1400	1500
6	720	840	960	1080	1200	1320	1440	1560	1680	1800
7	840	980	1120	1260	1400	1540	1680	1820	1960	2100
8	960	1120	1280	1440	1600	1760	1920	2080	2240	2400
9	1080	1260	1440	1620	1800	1980	2160	2340	2520	2700
10	1200	1400	1600	1800	2000	2200	2400	2600	2800	3000
20	2400	2800	3200	3600	4000	4400	4800	5200	5600	6000
50	6000	7000	8000	9000	10000	11000	12000	13000	14000	15000
100	12000	14000	16000	18000	20000	22000	24000	26000	28000	30000

4×16 and 8×8.

Fractions over ½ added, others excluded.

No. Pieces	12	14	16	18	20	22	24	26	28	30
1	64	74 2/3	85 1/3	96	107	117 1/3	128	138 2/3	149 1/3	160
2	128	149	171	192	213	235	256	277	299	320
3	192	224	256	288	320	352	384	416	448	480
4	256	299	341	384	427	469	512	555	597	640
5	320	373	427	480	533	587	640	693	747	800
6	384	448	512	576	640	704	768	832	896	960
7	448	523	597	672	747	821	896	971	1045	1120
8	512	597	683	768	853	939	1024	1109	1195	1280
9	576	672	768	864	960	1056	1152	1248	1344	1440
10	640	747	853	960	1067	1173	1280	1387	1493	1600
20	1280	1493	1707	1920	2133	2347	2560	2773	2987	3200
50	3200	3733	4267	4800	5333	5867	6400	6933	7467	8000
100	6400	7467	8535	9600	10667	11733	12800	13868	14933	16000

8×10 or 5×16.

Fractions over ½ added, others excluded.

No. Pieces	12	14	16	18	20	22	24	26	28	30
1	80	93 1/3	106 2/3	120	133 1/3	146 2/3	160	173 1/3	186 2/3	200
2	160	187	213	240	267	293	320	347	373	400
3	240	280	320	360	400	440	480	520	560	600
4	320	373	427	480	533	587	640	693	747	800
5	400	467	533	600	667	733	800	867	933	1000
6	480	560	640	720	800	880	960	1040	1120	1200
7	560	653	747	840	933	1027	1120	1213	1307	1400
8	640	747	853	960	1067	1173	1280	1387	1493	1600
9	720	840	960	1080	1200	1320	1440	1560	1680	1800
10	800	933	1067	1200	1333	1467	1600	1733	1867	2000
20	1600	1867	2133	2400	2667	2933	3200	3467	3733	4000
50	4000	4667	5333	6000	6667	7333	8000	8667	9333	10000
100	8000	9334	10667	12000	13333	14667	16000	17337	18667	20000

3×14 or 6×7.

Fractions over ½ added, others excluded.

No. Pieces	12	14	16	18	20	22	24	26	28	30
1	42	49	56	63	70	77	84	91	98	105
2	84	98	112	126	140	154	168	182	196	210
3	126	147	168	189	210	231	252	273	294	315
4	168	196	224	252	280	308	336	364	392	420
5	210	245	280	315	350	385	420	455	490	525
6	252	294	336	378	420	462	504	546	588	630
7	294	343	392	441	490	539	588	637	686	735
8	336	392	448	504	56	616	672	728	784	840
9	378	441	504	567	630	693	756	819	882	945
10	420	490	560	630	700	770	840	910	980	1050
20	840	980	1120	1260	1400	1540	1680	1820	1960	2100
50	2100	2450	2800	3150	3500	3850	4200	4550	4900	5250
100	4200	4900	5600	6300	7000	7700	8400	9100	9800	10500

7×20 and 10×14.

Fractions over ½ added, others excluded.

No. Pieces	12	14	16	18	20	22	24	26	28	30
1	140	163 1/3	186 2/3	210	233 1/3	256 2/3	280	303 1/3	326 2/3	350
2	280	327	373	420	467	513	560	607	653	700
3	420	490	560	630	700	770	840	910	980	1050
4	560	653	747	840	933	1027	1120	1213	1307	1400
5	700	817	933	1050	1167	1283	1400	1517	1633	1750
6	840	980	1120	1260	1400	1540	1680	1820	1960	2100
7	980	1143	1307	1470	1633	1797	1960	2123	2287	2450
8	1120	1307	1493	1680	1867	2053	2240	2427	2613	2800
9	1260	1470	1680	1890	2100	2310	2520	2730	2940	3150
10	1400	1633	1867	2100	2333	2567	2800	3033	3267	3500
20	2800	3267	3733	4200	4667	5133	5600	6067	6533	7000
50	7000	8167	9333	10500	11667	12833	14000	15167	16333	17500
100	14000	16333	18667	21000	23333	25667	28000	30333	32667	35000

PLANING-MILL MACHINERY.

ITS SELECTION, ARRANGEMENT AND CARE.

In times when business must be done on small margins, and when the most lively competition presses all branches of trade and manufacture, a new significance is given to the aphorism that "economy is wealth." Though not its derivative signification, economy really means, "well-ordered arrangement," and the benefits to be derived from such a system as will produce the best and greatest results with the least expenditure, are perhaps more marked in the manufacture of wood into its various forms of use than in any other line of industry. Often the same firm will own the pine land, cut the logs, haul them to streams controlled by themselves, drive them to their saw-mills, saw them, convey the mill product in their own vessels to the manufacturing and wholesale points, unload at their private docks, kiln-dry, and manufacture at their own planing-mills into the many forms demanded by the trade, thence shipping directly to the retail markets; thus bringing under one management all the various stages of production, manufacture and transportation that, in most lines, are divided among many parties.

This concentration of such various and far-extended lines of operation calls for the highest executive ability and the keenest insight into detail, lest the advantage to be gained by leading into one channel so many streams of industry should be lost by the friction and leakage thereby likely to result.

Perhaps at no point in this chain of operations is the need of the personal oversight of the owner greater than at the mills, and there it is often most lacking. For this reason, the man of small means who simply owns or runs a mill, but who applies practical and scientific knowledge in its constant, personal oversight, can successfully compete with the great firms whose immense affairs cannot be conducted with such absolute economy as rules in his smaller establishment. The object of these pages is to offer a statement of facts and some suggestions, based on the experience of practical mill men and professional engineers, in regard to the best and most economical construction and arrangement of planing-mill machinery.

In studying this subject, the first thing that comes under consideration is

the character and amount of power required, and as steam power is almost entirely used in planing-mills the discussion of water-power will be omitted and steam power will be alone considered.

In very few lines of manufacture are such varying and sudden demands made upon the power as in a planing-mill. The sudden starting of heavy planers and saws strains an engine to its utmost, and if it is not strong enough, costly repairs and delays draw heavily upon the profits of the business. The work to be done should be accurately calculated, and the engine and boilers adapted to this result, making them powerful enough to drive all the machinery intended to be put in, even if all started at once. If the boilers have too limited steam room, excessively hot fires must be kept up, in order to generate steam of sufficiently high temperature and pressure to supply the demand, and the result is that there is danger of burning the boiler, and unequal expansions and contractions cause leakage, fractures, etc., and drawing more steam from a boiler than it was calculated to supply, often causes pulsation which soon tears it to pieces.

The kinds of boilers and engines required for various mills depends so much on local conditions that no one form can be recommended as applicable to all of them. Proprietors and managers and engineers have their preferences, and can profit by the experience of other mills in similar localities. A few years ago furnaces were built with a view to consuming all the fuel possible for the purpose of getting rid of the shavings; but a change has taken place and now economy in fuel is a necessity. There is no doubt that the more simple the construction of a boiler the less likely it is to get out of order, and the less care and skill is required on the part of the fireman or engineer, and where economy of fuel is a secondary matter, the plain cylinder boiler is the safest and most easily cared for and repaired. Where proper attention and skill can be given to the care of a boiler, experience has shown that the tubular gives the best results; the flue boiler is, however, very extensively used in planing-mills, as a practical and valuable compromise between the cylinder and tubular forms. But whatever form is determined upon, if the engineer has not a thorough technical knowledge of the subject, a responsible firm should be selected to build it, and to them, having been informed of the kind and amount of work required, should be intrusted the proportions. But some principles can be profitably laid down for the guidance of the purchaser.

The size of the water and steam room of a boiler should be determined, partly, by the character of the fuel. It is evident that in a fire fed by shavings and mill refuse there cannot be maintained a steady heat, and with a small quantity of water the temperature would change with every change of the fire, while a larger amount of water would retain heat for a longer

time, and the amount of steam given off would not be sensibly affected in so short a time.

Many of the best authorities disparage the value of the dome. It adds but very little to the steam capacity, while it weakens the boiler to a disproportionate extent. A steam dome of ordinary size will add but about one-tenth to the steam capacity of the boiler. It would act as an antiprimer, and would supply drier steam if the metal of which it is made were kept at the same, or higher, temperature as the other part of the boiler; but, as the dome is usually exposed to the action of the air, it is kept at a lower temperature than the main part of the boiler, and cools the steam coming in contact with it, producing partial condensation; and thus it happens that steam taken from a dome is often more wet than that in any other part of the boiler. While the steam room should be ample to meet sudden demands from the engine, the reservoir of power is mainly in the heated water. With a working pressure of 60 pounds, each cubic foot of steam in the boiler will produce only 4.65 cubic feet of steam at atmospheric pressure; but one cubic foot of water in the boiler will produce nearly 35 times that amount, as at 60 pounds pressure the temperature of the water is 307.5°, or 95.5° above the boiling point at atmospheric pressure; and as every degree of heat added to water already at 212° may be taken as competent to generate 1.7 cubic feet of steam, 95.5° will produce 162.35 cubic feet, or nearly 35 times as much as one cubic foot of steam at 60 pounds pressure.

In general, according to the best authorities, water should occupy three fourths of the boiler room, and, within limits, the larger the boiler, the more economical will be the use of fuel. The following table may be of value, it is given by Roper, and can be relied upon as being as accurate as any that can be obtained:

Table Showing the Proper Diameter and Height of Chimney for any Kind of Fuel.

NOMINAL HORSE-POWER OF BOILER.	HEIGHT OF CHIMNEY IN FEET.	INSIDE DIAMETER AT TOP.
10	60	1 foot 2 inches
12	75	1 " 2 "
16	90	1 " 4 "
20	99	1 " 5 "
30	105	1 " 9 "
50	120	2 feet 2 "
70	120	2 " 6 "
90	120	2 " 10 "
120	135	3 " 2 "
160	150	3 " 7 "
200	165	3 " 11 "
250	180	4 " 4 "

"For stationary boilers, the area of the chimney should be one-fifth

greater than the combined area of all the flues or tubes. In boilers provided with any other means of draught, such as a steam-jet or a fan-blower, the size of the chimney is not so important as it is in cases where the draught is produced solely by the chimney.

Rule for finding the Required Area of Chimney for any Boiler.—Multiply the nominal horse-power of the boiler by 112, and divide the product by the square root of the height of the chimney in feet. The quotient will be the required area in square inches.

According to the experiments of Mr. Isherwood, the best proportion for the draught area is one-eighth of the area of the grate. Many constructors, however, make it greater, amounting in some cases to one-seventh and one-sixth. Others make it less, one-tenth being not uncommon. But experience has shown one-eighth to be the most practical proportion, and the one capable of producing the most satisfactory results."

It is unnecessary here to give figures as to the number and size of the flues, amount of heating surface, size of fire-box, ash-pit, etc., which are furnished by the engineer in charge. The boiler room should either be located at a distance from the mill, or should be so protected by brick or iron-covered walls that there will be no danger of a fire starting there communicating with the main building.

The engine room should also be entirely separated from the mill, but, in this case, for protection to the engine, as the dust which abounds in a planing-mill should be kept from the engine as far as possible.

For planing-mill use an engine is to be recommended that has as little brass and bright work as possible, as, in spite of all precautions, it cannot be kept clean without being continually wiped off, and engineers soon tire of this, the consequence of which is it goes about half clean, when it looks worse than the wrought iron painted, as this can be wiped once a day and look comparatively clean. It is well to repeat what has been mentioned as to the power of engines. The engine should be large enough to drive, easily, all the machinery at once, that is intended to be put in, and a little extra power will be an advantage in the long run. To insure steady motion the driving pulley should be as large as expedient and of a weight of 600 pounds to the inch of cylinder diameter, and the piston should have a speed of from 350 to 400 feet per minute.

To find the horse-power of an engine, multiply the area of the piston in square inches, by the speed of the piston in feet per minute, and divide the product by 33,000. The result is the horse-power value of one pound mean effective pressure, and if multiplied by the whole mean effective pressure, will give the indicated horse-power. Another nearly correct method, easy to remember and correct enough for ordinary purposes, is as follows: Multiply together the square of the diameter of the cylinder in inches, the length of the stroke in inches, the number of revolutions

per minute, and the steam pressure; multiply the product by four and cut off six figures at the right.

Not infrequently is it the case that a person wishes to approximately determine the transmitting power of a given size without the trouble of making a calculation, and to assist this class the following table is given:

Cylinder.	7½	x12	in..	10	horse-power	Cylinder.	12	x20	in..	30	horse-power
"	8	x15	"	12	"	"	12	x24	"	35	"
"	8	x16	"	15	"	"	14	x20	"	40	"
"	9	x15	"	15	"	"	14	x24	"	50	"
"	16	x14	"	20	"	"	15	x24	"	55	"
"	10	x15	"	20	"	"	16	x30	"	85	"
"	10	x20	"	25	"	"	16	x31	"	90	"
"	12	x15	"	25	"						

The amount of power necessary to drive a planing-mill can easily be calculated from the figures given below:

30	inch	surfacer,	1	side	.....	8	horse-power.
30	"	"	2	"	10		"
24	"	"	1	"	 6		"
24	"	"	2	"	 8		"
14	"	planing and matching machine.			 6		"
14	"	"	"	"	with 2 cylinders. 7		"
8	"	moulding machine,	4	sides	 5		"
6	"	"	"	4	" 3		"
Circular saws, for each inch of cut above table.. 1							"
Band resawing machine, to 1 inch of blade..... 3							"
Blower for shavings.....5 to 8							"

These figures are mostly from J. E. Richard's calculations, and are as nearly correct as can be made.

SHAFTING AND PULLEYS.

Following the subject of power will appropriately come the consideration of the methods by which the power is transferred from the engine to the machinery; viz.: shafting, with the accompanying bearings, hangers, pulleys, etc., and the modes of erecting them.

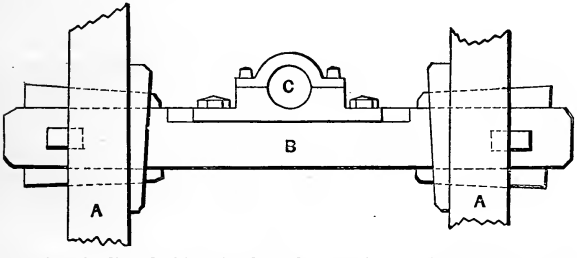
Tables of strength of materials show that cold rolled shafting is much superior to the hot rolled for whatever purpose it is used. Its resistance to torsion. or twisting, is 30 per cent. greater than that of the latter.

Hangers for line shafting in planing-mills should be of sufficient strength to tear asunder the belts which are carried upon the shaft they support, without breaking; otherwise serious accidents from winding belts may occur, in consequence of the width and strength of such belting as it is necessary to use. A "cored section" for a hanger, is the only kind which should be used in such mills. These are made of sufficient strength by the best manufacturers, and it is therefore unnecessary to give here any figures as to their proper size or weight.

They should be placed at a distance apart not to exceed 10 feet; 8 feet

is far enough in large mills where a great many machines are used, and in fact in any mill, whether large or small, is as far as they should be placed. Bearings for such hangers should be 4 diameters in length in all cases for the size and speed now under consideration.

The following cut illustrates the hanger most in use for heavy line shafting, and which is adapted particularly to saw-mills, where shafting may often require lining up. A, A—are the supports bolted to the ceiling, or which may be extended to the floor. The cross-bar, B, has a long tenon passing clear through the mortise in the supports, and held in place by double sets of keys, thus allowing of vertical and lateral motion. C is a section of the shaft:



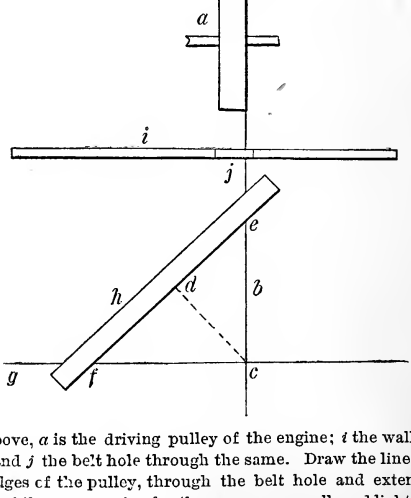
Pulleys for line shafting should be built with wood faces and perfectly balanced, no mattter how slowly they are to be run, and all of the same size, or as nearly so as practicable. The size of tight and loose pulleys upon planers can be arranged to correspond by specifiying the proper size when ordering the machine from the builders. Those of 36, 38 or 40 inches diameter are as good sizes as can be built for main line shafting, and with it running from 240 to 280 revolutions per minute, the requisite speed is produced for the machines.

The difference between iron and wood pulleys as to the relative value for transmitting power is shown in the following table from "Haswell," the standard authority on such subjects, in this country:

PORTION OF CIRCLE EMBRACED BY BELT.	RELATIVE VALUE OF LEATHER BELTS.	
	ON WOODEN PULLEYS.	ON IRON PULLEYS.
.20	1.80	1.40
.30	2.40	1.70
.40	3.30	2.00
.50	4.40	2.40
.60	5.90	2.90
.70	7.90	3.40

From this we learn that the ratio of friction to pressure for leather belts upon wooden pulleys is .47, and upon smooth cast iron .24. It is claimed by many, especially by manufacturers of iron pulleys, that they are far superior to wood in their hold upon belts, but such assertions are not supported either by experience or reference to the best mechanical works we have. Sufficient has been said upon this subject to enable anyone to of ordinary intelligence to decide as to what a line shaft and the hangers and pulleys for same should be. The next step to be considered is how to put them in working position.

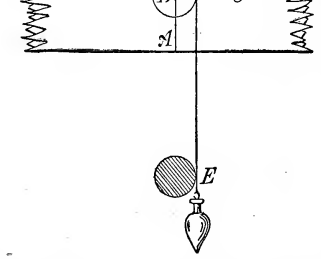
As in all other mechanical work, this involves calculation and accurate measurement. Great care should be exercised in obtaining a starting point for a main line; for if that is wrong all will be wrong that follows. To determine this, the following method, illustrated by a diagram, is used by some millwrights, and is the best one, where the engine is situated outside the main building and where there is no convenient way of getting measurements from its crank shaft:



In the above, *a* is the driving pulley of the engine; *i* the wall of main building, and *j* the belt hole through the same. Draw the line *c* parallel with the edges of the pulley, through the belt hole and extend it past the middle of the room, using for the purpose a small cord lightly chalked to make as fine a mark as possible. When the line is perfectly straight

and parallel with the pulley edges mark upon it the center of the room, as indicated at *c* in the sketch, and upon this point place one leg of a pair of large dividers opening 3 or 4 feet, allowing the other to rest anywhere above the line, as at *d*. Now with *d* as a center, carry the distance *d c* around until it intersects the line *c* as at *e*. Mark the two points *d* and *e*, and with the straight edge *h* touching each, carry the distance *d e* around in a similar manner until it intersects the straight edge at *f*. Mark the point *f* plainly upon the floor and removing the straight edge draw the line *g* the entire length of the room passing it through *f* and *c*. If the points have been produced with care and accuracy it will be perfectly parallel with the face of the driving pulley *a*. Th s line should be deeply marked in the floor that it may be permanent and distinct. From it as many other lines, and at such places in the room as may be desired and parrallel with it, can be easily produced; also from one story of a building to another.

The center lines can be transferred to the timbers of the ceiling and accurately fixed, at points desired, by the use of plumb lines with fine centering bobs.



In putting up shafting to a center line marked upon the timbers, as directed, a few suggestions may be of service. Referring to the accompanying engraving, *C* represents the timbers to support the hangers. Frequently there are two timbers running parallel with the line shaft for supporting the hangers. Should such be the case, narrow strips of board may be nailed across them, and the same directions here given applied with equal effect. A straight edge *D*, made of a well-seasoned strip of pine, and planed perfectly straight upon one edge, should be placed upon the timbers. *D* should be long enough to more than cover two of the timbers *C*, so that two plumb lines can be dropped for each length of shafting.

Carefully measure the length of shafting to be put up with a pair of calipers, and, using a steel rule or scale, set a pair of sharp-pointed dividers to a radius of half the diameter of the shaft. With one point of the dividers upon the center line *A*, describe a circle *B* equal to the diameter

of the shaft, and drop a plumb bob *E*, with the line touching the edge of the straight edge and circle *B*. The shaft is then to be moved, so as to just touch the line at *E*, which brings it directly under the center line.

From a "ground line" obtained in this manner a building four stories in height and 200 feet in length has been fitted from top to bottom with shafting and machines which were belted up from the engine to the last machine before a single pulley was put in motion, and when the engine was started every belt took its proper track and followed it correctly; not one having to be removed or a shaft changed.

The following method of straightening bent shafts is given by the mechanical journals, and is so simple and easy of application that it is given here: "Heat the bent shaft red hot, rest horizontally by pieces placed under each end, and apply water to the rounding side of it. This will permanently contract that side. When the shaft is black-hot about one inch deep, heat it red hot again as before and repeat the operation, and so on. This process will straighten a shaft of any diameter without damaging it by blows."

SPEED OF PULLEYS.

To find the number of revolutions of a driven pulley when its diameter and the diameter and number of revolutions of the driving pulley are given: Multiply the diameter of the driving pulley by its number of revolutions and divide the product by the diameter of the driven pulley.

To find the size of a pulley which will make any given number of revolutions when the diameter of the driving pulley and its number of revolutions are given: Multiply the diameter of the driving pulley by the number of revolutions it makes and divide the product by the number of revolutions required for the driven pulley.

To find the size of the driving pulley when the diameter of the driven, the number of revolutions it is to make, and the number of revolutions of the driving pulley are given: Multiply the diameter of the driven pulley by the number of revolutions you wish it to make, and divide the product by the number of revolutions made by the driver.

BELTING.

Rules cannot be given to show the exact amount of power rubber or leather belts will transmit when used in a planing-mill. They may do for machine shops, where the motion is slower, and where belts may be kept well oiled and soft. In wood working establishments they are always more or less dry and dusty, and are kept running constantly at a high rate of speed. The effect of dust on the face of a belt is to materially decrease its tractive power. This is also decreased in proportion to the in-

crease in the speed of the belt, in consequence of the centrifugal force developed by its motion, which varies with the belt's speed, tension and weight. A belt moving at the rate of 5,000 feet per minute will not have over three quarters of the contact shown by a diagram taken when it is at rest. The heavier the belt, the more powerfully is the force exerted; hence it is always desirable to use belts as light in weight as possible for high speed machines.

Rubber belts should never be used for high speed machinery, nor upon small pulleys, as they are apt to tear out at the joints and edges. For driving belts upon large pulleys they are by many considered superior to to leather. The requisites for a good driving belt are weight, strength, straightness and tractive power, all of which are combined to a very great extent in first-class rubber. The weight of a driving belt over 8 inches wide should be such that when running at an angle of 25° no other strain than its weight will be necessary. In this respect rubber excels leather, as its weight is about one-sixth greater. It is also affected in a less degree than leather by dust and dryness.

For counter shafts with tight and loose pulleys, only the best leather belting should be used and all such belts over 7 inches in width should be double, unless for very high speeds and over small pulleys; which if proper care is used in designing and building mills will never be necessary. The reason that belts should be double whenever it is practical to use them, is that when they come to be stretched, fewer irregularities develop themselves than in single belts of the same width, which, as they are required to run as evenly as possible, is an important point. When single belting must be used that known as short lap should always be selected, for as a rule any belt having long laps at its glue points, will stretch unevenly and soon wear out. In a first-class article of this kind the lap in no case exceeds in length the width of the belt. Never buy an inferior belt because its first cost is small, for it is almost certain to prove by far the most expensive in the end.

For joining leather belts use studs. They will not weaken the belt as much as lace hooks or other fastenings requiring holes. They are quickly and easily adjusted, make a smooth joint and no disagreeable noise in passing over a metal pulley. Rubber belts should be joined only by the best lace leather; any metal fastening will soon tear out. To keep leather belts soft, use neatsfoot oil; never use soap, resin or any gummy substance, as it will, in the end, destroy them. Round belts are preferable for driving the feed works of planers, or saws, as they occupy little room and allow the use of more cones. They are not so much affected by dust and shavings, and do not require so much attention to keep them in order.

Belts are too frequently injured by being allowed to rub against some

fixed object, either tight pulleys upon which they try to climb, or a post or other contiguous object. At first it may only touch at one point, but if not remedied the evil grows until a ruined belt is the result. A belt always runs toward the near end of a shaft, or lower side of the driven pulley.

RE-SAWING MACHINES.

The band saw is unquestionably the best re-sawer, and is now becoming generally used for that purpose. Its blade is of superior thinness, it is capable of being adjusted with different degrees of tension, moves in right lines through the lumber and at an almost unlimited rate of speed, and is operated wholly by rotating machinery of the simplest construction.

In considering saw teeth, we have first, pitch (distance between teeth); the inclination on front and back of the tooth (cutting angle); the form of the gullet, as it is termed, for holding the dust; the width of the base of the tooth, so as to give sufficient stiffness to retain the set, and the kind of set given to the teeth. The thinness of band saw blades calls for every minute condition that will tend to keep them true and cause them to run in line.

For soft wood, a pitch equal to one-half, and a depth equal to one-fifth of the width of the blade, is as near a general rule as can at this time be suggested. For hardwood a closer pitch of one-third the width is better. The gullet or throat under the tooth should in all cases be circular; not only to guard against breaking or checking in the corners, but to prevent the dust from lodging; as with an acute angle it can be carried in quantities on to the wheels. For the front inclination of the teeth, it should be sufficient, so that when the saw is sharp there will be no back thrust on the blade; a thing that must in each case be determined by the observation of the operator, and the character of the timber to be cut.

The matter of setting must be determined by the thickness of the blade and character of the wood. In sawing pine, or other soft woods, the teeth can be bent from the base, and will retain their set; but in hardwood or knots this kind of setting does not last long, but soon "comes out," to use a lumberman's expression. Upsetting the teeth is impracticable with thin saws, or is at least very difficult, unless the plates are No. 14 or thicker. The temper besides is, or ought to be, too high in bandsaws for upsetting. The best plan of setting developed in the writer's experience, in band-sawing, is a quick abrupt bend on the bottom of the tooth by sharp blows from a light hammer—setting the steel, as it were, off to one side and raising a kind of scraping edge on the cutting side of the tooth. It is easy to get a regular set in this manner, and it requires

no special skill to perform it; it is, besides, sooner done, no gauge being required. The saw is passed over an anvil, with its top bevelled to a proper angle, the bottom of the tooth projecting over the bevel, from a sixteenth to one-eighth of an inch, according to the amount of set required. These remarks upon teeth relate to saws intended for power or positive speed. For scroll sawing or plain hand slitting it is presumed that no information of interest could be given, and that none is needed.

A band saw for re-sawing should not be more than 3½ inches in width nor less than 40 feet in length. The band wheels over which the saw runs should be from 6 to 8 feet in diameter, made of wrought iron and with the rims covered with leather. The saw should have a speed of from 6,000 to 8,000 feet per minute.

PLANERS AND MATCHERS.

For surfacing, chain feed machines possess many points of advantage. Lumber can be planed on them in almost any condition, even if covered with ice or snow, which can hardly be done with the roll feed. In starting a new chain feed planer, much attention should be given to the wearing parts of the bed and its bearing bars to prevent abrasion, as, if this evil once commences, it can never be stopped. Powdered plumbago (black lead) mixed with oil is the best lubricant that can be used to prevent it. The bearing bars beneath the bed should be faced with highly tempered steel; the traveling bars should be made of chilled iron; the straps of the best grades of Norway or Swedish iron, and the rivets of steel. Great care should be exercised in the manufacture of these parts, especially such portions of them as are exposed to wear, as they are often required to work under heavy pressure, covered with dust and with but little chance for proper lubrication, and if they are not well constructed and cared for, they will prove a continual source of trouble and expense.

The matcher has undoubtedly been made in a greater variety of forms to accomplish the same result than any other wood cutting machine in use. There seems to be nothing like a standard for any one of its parts in existence; each builder designs his machine seemingly with no other purpose than to make it as much unlike that of his predecessor in the business as possible. At least such is the opinion one would naturally form from an examination of the different patterns which are offered for sale in this country They are built with 2, 4, 6 and 8 feed-rolls, from 4 to 14 inches in diameter, as extremes, the large ones sometimes fluted and the small ones with smooth surfaces and *vice versa*. We find cylinders varying from 4 to 10 inches in diameter, some with 2, some with 3, and some with 4 knives which are attached in divers ways. In one style they are inserted in the cylinder with their cutting edges projecting past

its turned surface; in another they are keyed to the cylinder and in a third, bolted upon it. Again, in some machines the cylinder is round as its name would indicate, and in others rectangular and triangular. The cylinders, too, are made of various materials, the most common of which are wrought iron, cast iron and brass. In matcher or side cutter heads the same dissimilarity prevails. They are made to carry from 2 to 5 cutters. These are in some cases solid and in others in sections; in one machine placed with the beveled side of the cutter out, or next to the work, and in another in the opposite positions; sometimes straight and frequently with an edge forming a quarter of a circle, and all these different classes at work on the same kind of wood and under like conditions.

It is not the province of this work, however, to find fault with the machinery makers, or to make invidious comparisons. There are many very excellent machines manufactured from which to make a selection. They will all do good work if properly handled and cared for, and the matter of choice resolves itself into the predilections or prejudices of the operator.

BEARINGS.

The bearings of a planer require more attention than those of almost any other machine in use. The very high rate of speed at which the spindles are necessarily run, the sudden and severe strains they often receive, and the fine dust which collects upon every part, absorbing the lubricants and impeding their free operation renders it vitally important that constant care should be exercised to keep them in proper order, that they may run without heating and produce smooth work.

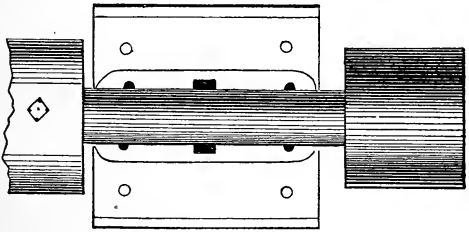
Spindles should be made of rolled or cast steel, cut from the bars and properly shaped in the lathe, but should never be put into the fire. Steel is superior for this purpose in many important particulars, though until quite recently the latter was almost exclusively used. The torsional strength of steel is 75 per cent. greater than iron, and its cohesive strength nearly 140 per cent. greater.

Never pour hot babbitt-metal on an arbor if it can be avoided. Turn a piece of common shafting up just enough larger than the bearing to overcome the shrinkage of the metal, and use this "templet" instead of the shaft, in the manner hereafter described. Brass bearings are best, but babbitt-metal is most generally used on account of cheapness and ease of replacing.

It is often the case that when a planing machine is started up, just after the cylinder bearings have been newly fitted, that smooth work cannot be turned out, while it is just the time when it would naturally be expected that the machine was in the best of order; instead, it makes the surface

of the lumber uneven or " wavy," as it is termed in planing-mill parlance. The usual remedy—if remedy it may be called—is to let them "wear down," operators seemingly entertaining the impression that they will be all right after a few days' wear. This practice is decidedly erroneous, and results from an improper method of moulding the cylinder bearings.

Both sections of a bearing should be poured at one operation, and not at two as is frequently done. The cylinder should be made parallel with the bed of the machine by placing two pieces of brass of equal thickness under it, and then raising or lowering it until the proper amount of space is left between the shaft and shell to be filled with metal. When this has been done satisfactorily, fill what space remains between the end of the cylinder and the shell with putty or clay, that there may be no outlet for the metal, and put on the proper amount of packing, which should be of heavy brown drawing paper as it is easily removed as the bearings wear, and it becomes necessary to take up the lost motion. This should be fitted close to the shaft, as shown in the accompanying engraving, leaving a



moderate sized hole in the middle upon each side of the shaft for the metal to pass through, and a vent hole at each end for the escape of air and the gas which will be generated by the heated metal. After this is done put on the upper section of the shell and secure it firmly by means of screws or bolts: then fill up the space at the ends tightly with putty, except at the top, where leave a goodly sized vent hole. This latter is an important safeguard and should never be omitted, as without it there is considerable danger of a blow-up which is liable to result disastrously both to the bearing and the mechanic who is attempting to make it.

When the bearing has been carefully prepared in the manner above described, examine it carefully and see that there is nothing to interfere with the successful completion of the work. The next step is to melt the metal, an operation which though apparently simple, requires some judgment and experience. The most important direction to be observed is not to over-heat it. A good rule for testing the heat of metal is to in-

sert in it, as it is melting. a dry pine stick; when it will cause this to smoke it is abundantly hot, and in warm weather and with large holes for the metal to pass into the mold, even hotter than is necessary. It is a good plan to heat the cap a little before screwing it on, as the heat will be imparted to the shaft and lower portion of bearing thus preventing the babbitt metal from setting too quickly. Always pour the metal as rapidly as possible, but do not hurry; when once started, keep a steady stream running until the shell is filled. Let the bearing cool a little after pouring; then take off the cap, which may be easily done by inserting a cold chisel between it and the lower section to break off the gates, which will yield readily if the metal is what it should be, and next proceed to fit up the bearing. which portion of the work is the most important of all, the whole success of the operation depending upon its being properly performed.

Provide some red lead mixed with oil and a half-round scraper, which may be made if desired from an old half-round file ground from the flat side. Put a thin coating of the lead on the upper portion of the shaft as it lays in the bearing and turn it around a few times; when it is raised out of the bearing the red lead will show where the shaft rests. This will be found almost invariably to be upon the sides of bearing on account of the shrinkage of the metal, and will seldom be found to touch the bottom. Wherever the red lead appears, remove carefully with the scraper a small portion of the metal. The lower part of the bearing should be perfectly fitted before the other half is commenced. When that is completed, screw on the cap and manipulate the upper part in the same manner as the lower. After both sections are fitted perfectly, clean the shaft and bearings of all chips and dust, oil with good sperm oil, and screw down the cap firmly upon the packing, leaving the shaft loose enough to turn freely, but not so loose as to jar.

The metal for the class of bearings which we have now under consideration, should be of the very best quality, and is perhaps best obtained from some reliable manufacturer of wood-working machines, by stating for what purpose it is to be used. For shafting and machinery which runs at a low rate of speed, a mixture of one part of antimony and five parts of pure lead will answer well, and is quite easily made. To mix it properly it should be brought to a red heat and thoroughly stirred up from the bottom of the crucible that the ingredients may be well united.

In moulding vertical bearings like those for side cutting spindles, two more gates or openings should be made through the packing on each side of the shaft, a trifle smaller than for horizonal bearings where only two are used. Pour from the top or upper end of the cap, and look well to the vent holes. In placing the packing, cover a portion of the paper rests upon the iron with glue, being careful not to place any where the

hot metal will come in contact with it, as this keeps the packing in its proper position while adjusting the cap, and will readily leave the iron when it is necessary to remove it. It is a good plan to cover the shaft with thin paper, as this will prevent the metal from cooling, and will leave it with a much smoother surface than when it is molded upon the bare iron.

LUBRICANTS FOR SHAFTING AND JOURNALS.

Use good lard or machine oil to lubricate shafting. The bearings should be provided with well regulated glass self-oilers. Never use a self-oiling box that feeds from the bottom by wicks or capillary attraction; they cannot be trusted. No good workman should trust what he cannot see.

The common practice of "squirting" the oil from a can is a bad plan and very wasteful. Generally where one quart is really used in this manner five are wasted; and thus mill owners are often induced to buy cheap oil under the impression that it lasts just as long as the best, as it certainly does when an operator thinks he must use just so much and apply it just so often no matter what the quality may be. For the journals of high speed machinery only the best lard or sperm oil should be used, and it should always be fed from an adjustible glass oiler placed on the top of the cap in plain sight. With this arrangement the writer has seen 24-inch machines with 8-inch journals run steadily for 10 hours, as a test, with only a teaspoonful of sperm oil to each journal, and at the end of that time the spindles were as cool as if they had run only half an hour. However incredible this may seem to those who are in the habit of applying more than that every 15 or 20 minutes, it is a fact that can be readily substantiated.

GRINDING AND SETTING CUTTERS.

This is one of the most important features in the successful operation of the planing-mill. The method of grinding cutters most commonly practiced is a poor one, resulting not only in a loss of time, but of cutters as well. This plan is illustrated in Fig. 1 of the accompanying diagrams, and

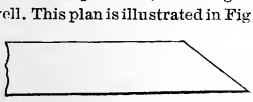


FIG. 1.

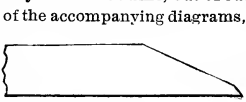


FIG. 2.

consists in grinding a single level upon the edge of the cutter, sometimes very short, especially if the grinding apparatus works slowly. When a cutter, ground in this manner, has been sharpened a few times with a file

a rounding edge is produced, unless a good deal of time and care is used in performing the operation of filing, and the wood is thus pounded or bruised off instead of being cut. Anyone accustomed to operating planing machinery can tell instantly by the sound a machine makes whether the cutters are cutting or pounding the wood. Fig. 2 shows the proper shape for planing knives. The short or filing bevel is the same as in Fig. 1 and is just as strong and no more liable to spring or fracture. By grinding the second bevel, the iron is removed, thereby rendering it an easy matter to keep the edge filed and sharpened; it also enables the operator to keep a smooth edge upon them, an edge made by the grindstone being unfit for use until the roughness has been removed by whetting. The best machine for grinding planer knives is an emery wheel, about 24 to 30 inches in diameter, and 2 inches thick, of a coarse grade, arranged with an automatic carriage for holding them. Such a machine well made and kept in good repair, will perform its work very rapidly and accurately.

After the knives have been ground they must, if the cylinder is to run steadily, be properly balanced. This can be done easily and quickly by using a pair of balances and grinding from the back, between the bolt

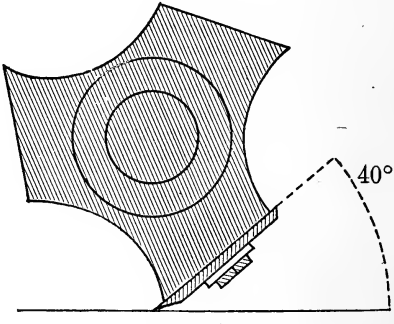


FIG. 3.

slots of the heaviest cutter. If the cylinder is rectangular, *i. e.*, with an even number of cutters, it is only necessary to have each cutter of the same weight as the opposite one, but if the cylinder is triangular, they must all be of the same weight. In balancing long knives, care should be taken to remove as nearly the same amount from each bolt slot as possible, that one end may not be heavier than the other, for should this be the case, the cylinder could never be made to run steadily, but would have a jarring motion, producing a bad effect upon the work and bearings,

One of the most important points to be noticed in connection with this subject is the angle at which the cutters stand to the surface being operated upon, and herein lies the whole secret of a planing machine perform-

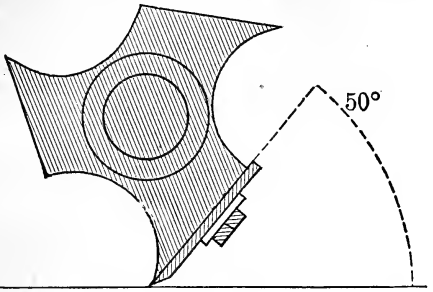


FIG. 4.

ing its work without tearing or slurring the surface of the board. This is a matter with which operators should be better acquainted than the makers of the machines, as they have an opportunity of observing the effect of cutters at different angles and upon various kinds of wood, while the builder has not, but must make his designs more from theoretical deductions than from practical experience.

It seems to have been the aim of most builders to get as low or acute an angle on as thin an edge for the cutters as possible. Now what is really

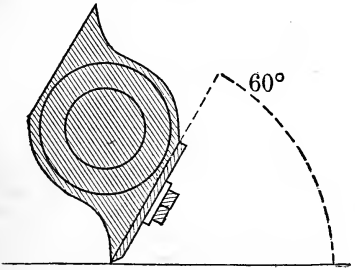


FIG. 5.

wanted is a sharp edge, and any mechanic knows that it is well nigh impossible to keep a thin edge sharp; as, if it is thin, it must necessarily be of a low temper to avoid the danger of breaking. On the other hand

the more obtuse the angle and the thicker the edge to a certain degree, the higher the temper of the metal may be, and the longer it will retain its sharpness. That a given amount of wood can be removed with less power by use of a thin knife than a thick one is evident, but there are cases where the power consumed becomes a secondary consideration and the quality of the work turned out the first.

For planing white pine and soft woods generally the angle shown in Fig. 3, is suitable. For partly soft and partly hardwood, that represented in Fig. 4 should be used. For hardwood exclusively, such as cherry, wal-

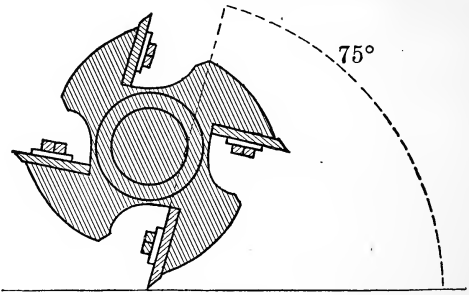


FIG. 6.

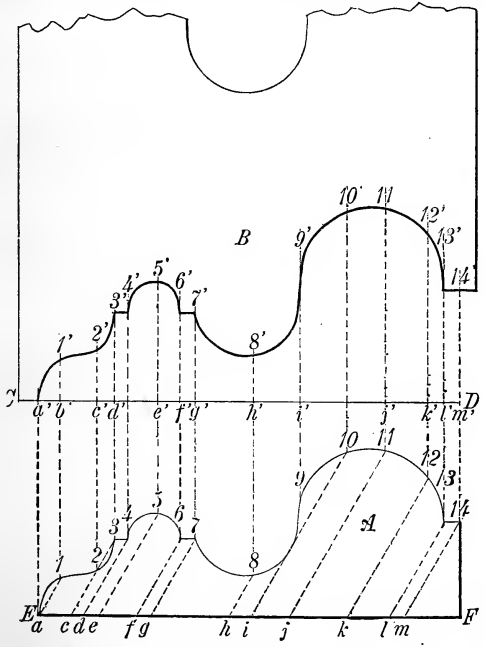
nut, oak, etc., the angle in Fig. 5 is best, while, for the very hardest varieties, such as boxwood, rosewood, ebony and similar woods, the angle should be high, as shown in Fig. 6. In some cases we even find them standing upon a radial line with the center of the cylinder, in such machines for instance, as those for making wave-mouldings.

FIG. 7.

Where knives stand at an angle suitable for soft woods, and it is desired to plane hard or cross-grained lumber, very good results may be obtained by grinding a slight bevel upon the face of the cutter, as seen at Fig. 7, which is in fact changing the cutting angle.

For determining the proper shape of moulding cutters the following rule will be found useful. In the accompanying figure *A* represents the moulding; through it at any convenient points draw the lines *a c d e* etc., at the same angle to the base that the cutter stands to the bed of the machine, which in this case we will assume to be 60°. At the points of inter-

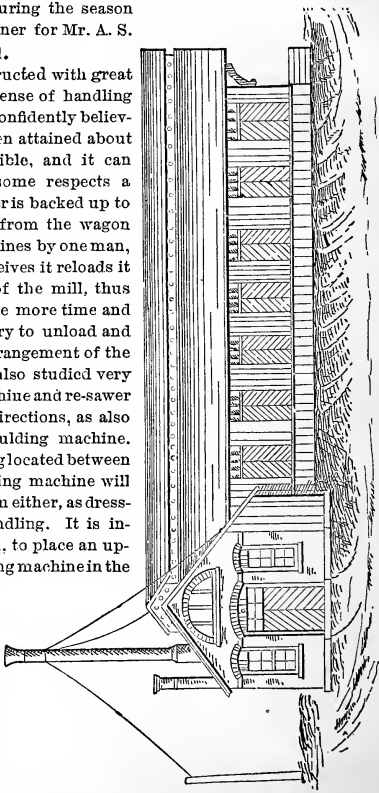
section of these lines with the outline of the moulding draw the ordinates a' b' c' d' etc., of any length and perpendicular to $E\ F$. At any convenient distance above A draw the ground line $C\ D$ parallel with $E\ F$. Extend each of the ordinates a distance above the line $C\ D$ equal to the length of each corresponding diagonal line on the moulding, so that b' 1' will just equal a 1; c' 2' will equal c 2, and so on. Through the points 1', 2', 3' etc., thus produced, draw a line connecting them, which will be the correct form of the cutter B. Great care must be taken to balance the cut-



ters perfectly that no jar may be produced to cause uneven work. The best material for cutters is iron overlaid with steel. Saw blades of 8-gauge and even less are often used with good success for light work, but are not solid enough for anything heavy.

A MODEL PLANING MILL.

In connection with this subject are presented full details of the construction and arrangement of what is considered a model planing-mill, designed and built during the season of 1881, by A. O. Gardner for Mr. A. S. Meriam, of Quincy, Ill.

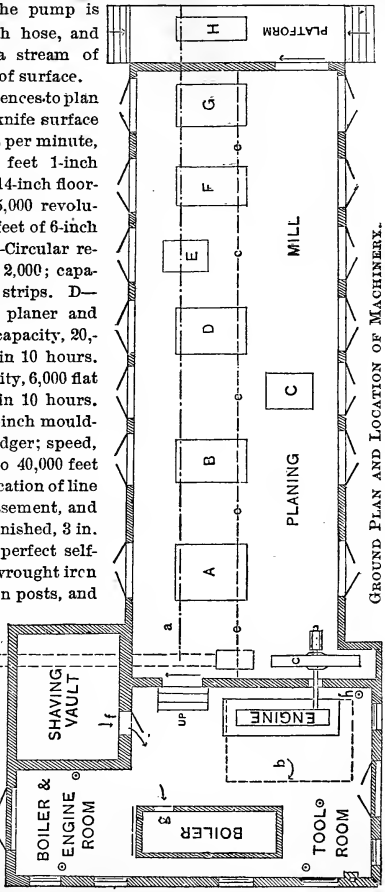


PERSPECTIVE VIEW.

This mill was constructed with great care to lessen the expense of handling the lumber, and it is confidently believed that the end has been attained about as nearly as is possible, and it can be presented as in some respects a "model." The lumber is backed up to the door and taken from the wagon directly into the machines by one man, while the one that receives it reloads it on the opposite side of the mill, thus expending only a trifle more time and labor than is necessary to unload and load it again. The arrangement of the machinery has been also studied very closely, the siding machine and re-sawer feeding in opposite directions, as also the rip-saw and moulding machine. The picket header being located between the moulder and siding machine will receive the pickets from either, as dressed, without extra handling. It is intended, when required, to place an upright, or band, resawing machine in the space between the surfacer and flooring machine. Great care has also been taken to guard against disaster by fire, all the roofs being coated with a fire-proof mixture of lime and salt, and all the woodwork in boiler and engine-room being saturated with the same, while steam pipes lead from the boiler to the shaving vault, which can be flooded at an

instant's notice with live steam, one of the most effective agents to quench fire that is known. The pump is plentifully supplied with hose, and is capable of forcing a stream of water over the whole roof surface.

The following are references to plan of mill: A—26-inch 4-knife surface planer, 5,000 revolutions per minute, with capacity of 40,000 feet 1-inch boards in 10 hours. B—14-inch flooring machine; speed, 5,000 revolutions; capacity, 20,000 feet of 6-inch strips in 10 hours. C—Circular resawing machine; speed, 2,000; capacity, 20,000 feet of 6-inch strips. D—8-inch double cylinder planer and matcher; speed, 5,000; capacity, 20,000 feet of 6-inch strips in 10 hours. E—Picket header; capacity, 6,000 flat or 4,000 square pickets in 10 hours. F—Bench rip-saw. G—7 inch moulding machine. H—Gang edger; speed, 3,200; capacity, 30,000 to 40,000 feet in 10 hours; (*a*) Shows location of line shaft, which is in the basement, and is of wrought iron, hot finished, 3 in. in diameter, fitted with perfect self-oiling boxes and patent wrought iron rim pulleys, and hung on posts, and runs at a speed of 200 revolutions per minute; (*b*) shows a solid flag stone coping 10 inches thick, the foundation of the engine; (*c*) fly-wheel of engine, 100 inches in diameter and 16-inch face, weighing 2,200 pounds; (*e*) line of suction pipe of exhaust fan; (*f*) door to shav-



GROUND PLAN AND LOCATION OF MACHINERY.

ing vault, the arrows showing the course of the shavings from the vault to the furnace of boiler; (*g*) exhaust fan, 40 inches in diameter and 18 inches wide, running 1,150 per minute; (*h*) pump supplying tank and boiler. The tank (not designated on plan) is horizontal, of boiler iron, and is located directly over the engine, at sufficient altitude to afford pressure enough for washing out the boiler; dimensions, 44 inches diameter, 12 feet long. The boiler is a horizontal tubular, 48 inches diameter and 12 feet long and contains 51 tubes 3 inches in diameter, and is fed by an inspirator, no heater or boiler pump being used. The engine is 12-inch cylinder with 18-inch stroke, with a lap valve cutting off at ¾ stroke and makes 140 turns per minute.

The mill building is very cheaply made, being a balloon frame. In size, including the platform upon which the gang edger stands, it is 20 feet by 64 feet. There were used in its construction, 52 perches of stone, 3 pieces 8x8 inches 12 feet long, 7 pieces 8x8 inches 16 feet long, 1 piece 8x8 inches 20 feet long, and 3 pieces 8x8 inches 24 feet long, 52 lower joists 2x12 inches 20 feet long, 25 upper joists 2x8 inches 20 feet long, 45 studding 4x4 inches 14 feet long, 16 pieces for plates 2x4 inches 16 feet long, 34 rafters 2x6 inches 14 feet long, 35 pieces 2x4 inches 16 feet long for braces and girts for nailing siding; 2,500 feet stock boards (siding), 2,600 lineal feet battens, 1,800 feet roof sheathing, 16,500 shingles, 3,000 feet 2x8s dressed and jointed for floor, 1,000 feet flooring for doors, 9 pairs glazed 9x12 sash (12 lights each with frames), and 250 feet ⅞ in. finishing lumber. In the construction of the boiler and engine room were used 14 perches of stone, 30,000 brick, 4 pieces 8x8 inches 20 feet long, 19 pieces 2x6 inches 20 feet long, 1 piece 4x8 inches 20 feet long, 750 feet sheathing, 7,000 shingles, 250 feet flooring, 12 pieces 2x8 inches 16 feet long for frames, and 9 pairs 9x12 glazed sash, 4 pairs 8-inch strap hinges, 1 sheet boiler iron 26x48 inches, 80 pounds bar iron and 6 bolts ½x9 inches for door and slides to shaving vault. The engine foundation required 3 perches of rough rock besides the cut stone coping, shown in the diagram, and 12 anchor bolts 1-inch in diameter and 4 feet long. In the boiler setting were used 4 perches of stone, 9,000 common brick, 300 fire brick, 4 anchor bolts 15 feet long, 2 anchor bolts 9 feet long, 5 anchor bolts 8 feet long, 6 anchor bolts 3 feet long, and 6 anchor bolts 2 feet long. The chimney is of No. 15 iron 40 feet high, stayed by 4 lines each 50 feet long. The belting required is as follows: 38 feet of 14-inch. double, 100 feet 7-inch single, 100 feet 6-inch, 70 feet 4½-inch, 100 feet 4-inch, 100 feet 3-inch, 30 feet 10-inch, and 50 feet 2-inch.

The method of belting from the line shaft up through the floor, as in this mill, is to be commended, as effectually obviating all annoyance and danger from over-head belting.

LAWS OF MECHANICS' LIENS.

Every state has its own laws governing mechanics' liens, and they differ widely with the different localities. In the pages which follow is given a digest of the laws of the states in which this book will circulate most generally. There is no collection of these laws in existence that the writer is aware of. The digests—so-called—occasionally to be found in collections of miscellaneous information are so meager and incomplete as to be of no practical value, and seem to have been written merely as an attractive title to an advertisement. We have attempted to give the full meaning of the law as it refers to the primary action necessary to secure a lien, but not the full process necessary on either side, as whenever suit is actually begun legal aid will be necessary in its prosecution. It is intended, however, to show what is the basis of a lien and the preliminary steps necessary to secure its advantages.

With the law of each state is given the title and date of the Revised Statutes or Compiled Laws from which it is taken. Any changes in legislation made since the dates given have been incorporated with the digests, so they may be taken as representing the condition of the law at this date —October, 1881. Beyond the open ng clause defining the application of the statute, merely the meaning of the law is given.

NEBRASKA.

Compiled Statutes of 1881. Page 343.

Any persons who shall perform any labor or furnish any material, or machinery or fixtures for the erection, repairing or removal of any house, mill, manufactory, or building or appurtenance, by virtue of a contract expressed or implied with the owner thereof, or his agents, shall have a lien to secure payment of the same upon such house, mill, manufactory, building or appurtenance, and the lot of land upon which the same shall stand.

Any person furnishing labor or material as above to any contractor or sub-contractor, who shall wish to obtain a lien upon any of the structures mentioned above, may file a sworn statement of the amount due him or them from such contractor or sub-contractor, together with a description

of the land upon which the same were done or used, within 60 days from the rendering of such service, with the clerk of the county in which the land is situated, and, if the contractor does not pay him, he shall have a lien for the amount due on such lot or lots and the improvements thereon, from the same time and in the same manner as the original contractor.

To secure a lien as above the person furnishing labor or material shall file a sworn itemized statement of the work done or materials furnished within four months from the time of rendering the service, and it shall operate as a lien for two years from the rendering of such service.

If a promissory note has been taken, a lien may be obtained by filing the same in the office of the county clerk with a sworn statement that the sum for which the note was given was due for service rendered as above.

Judgement may be obtained on a lien by civil action, and when suit is brought within the specified two years the lien shall continue until judgment is obtained.

Suspended work may be carried forward by the laborers, etc., engaged in the same, sufficiently to prevent the structure from going to waste.

If property cannot be sold because of defective title, or non-residence the owner, it shall be leased for the benefit of lien holders.

Persons rendering service as above on any railroad, canal or similar work shall have a lien upon the entire improvements of the company or corporation, including their right of way.

MISSOURI.

From Revised Statutes of 1879. Page 533.

Every mechanic or other person who shall perform any labor upon any materials, fixtures or machinery for any building, erection or improvements upon land, or for repairing the same, by virtue of any contract with the owner thereof, or his agent, trustee, or contractor, upon complying with the provisions of the statute, shall have, for his work done or materials, etc., furnished a lien upon such building, etc., and upon the land belonging to such owner on which the same are situated to the extent of one acre, or if in a village or city, upon the lot or land on which the building, etc., is situated. A building erected on leased lots or land shall be held for the debt contracted in erecting the same, and also the lease hold term for such lots or land.

Every original contractor within six months, every journeyman and day laborer within 30 days, and every other person within four months after the indebtedness shall have accrued, shall file with the clerk of the circuit court a full statement of the demand due him, with a full description of the property upon which the lien is to apply, which certified statement shall be a lien upon such property. Such lien shall take precedence

over all subsequent encumbrances. All actions shall be commenced within 90 days after filing the lien.

Ten days before the filing of such lien, notice of the same shall be given to the persons against whom the claim is brought. There shall be no preference among holders of liens for work done or material furnished as above.

Liens against a railroad shall be filed within 90 days after the completion of the work, and shall be on all the improvements and equipments of the railroad and on the right of way.

KANSAS.

Compiled Laws of 1881. Page 688.

Any mechanic or other person who shall, under contract with the owner of any piece of land, his agent or trustee, or under contract with the husband or wife of such owner, perform labor or furnish material for erecting, altering or repairing any building or the appurtenances of any building, or any erection or improvement, or shall furnish or perform labor in putting up any fixtures, machinery or attachment in or to any such building, etc., or plant and grow any trees, vines, plants or hedge, or build a stone fence, or build or furnish material for a fence on any tract of land, shall have a lien upon such buildings, etc., and upon the whole tract of land, for the amount due him for such work done or material furnished. Such liens shall have precedence of all subsequent encumbrances.

To obtain a lien, as above, a material-man or sub-contractor shall file a statement of the amount due, and the property upon which the work was done or material furnished, with the clerk of the district court, and a copy furnished to the owner of the premises within 60 days after the completion of the work or furnishing the materials, etc. An original contractor shall file the required statement, as above, within four months from the time of completion, etc.

Action to enforce such lien must be brought in the district court of the county, within one year after completion of such work, etc., and if there are several lien-holders they shall all be made parties to the action, and if their claims cannot be paid in full, payment shall be made *pro rata*.

ARKANSAS.

From Compiled Laws of 1874. Page 337.

Every mechanic, builder, artisan, laborer or other person, including contractors, sub-contractors and material-furnishers, who shall perform any labor upon, or furnish any materials, machinery or fixtures for, any building, erection or other improvement upon land, by virtue of any con-

tract, express or implied, with the owner thereof, or his agent, trustee, contractor or sub-contractor, shall have for his work done, or materials, etc., furnished, a lien upon such building, etc., and upon the land belonging to its owner, and upon which it stands.

A sub-contractor to obtain such lien shall, before he commences work, or furnishes materials, give notice to the owner of his intention, and the probable value of the work, etc., he will do. If after his contract is carried out he shall settle with the contractor in writing, and the settlement being certified by the contractor to be correct, the sub-contractor shall present it to the owner, etc., and within 60 days from the time his contract shall have been completed, the sub-contractor shall file with the clerk of the circuit court a copy of the settlement between him and the contractor; it shall be a lien upon the building, erection or improvement for which the things were furnished or the labor done. Then the employer shall become the surety of the contractor to the sub-contractor for the amount due for such service rendered.

Every person, except a sub-contractor, who wishes to avail himself of the advantages of lien shall within 90 days after the service has been rendered, file with the clerk of the circuit court a full statement of the amount due him, and a correct description of the property to be charged with said lien.

Liens shall be paid *pro rata*, except that the lien of a sub-contractor shall be paid before that of a contractor. Land not exceeding two acres lying conveniently around said building shall be subject to the above lien. The sale of property charged with a lien shall not affect previous encumbrances duly recorded, or of which the lien holders had due notice. No lien shall be for a greater amount than that stipulated in the original contract.

MINNESOTA.

From Revision of 1878. Page 871.

Whoever performs labor or furnishes materials or machinery for erecting, constructing, altering or repairing any house, mill, manufactory or other building or appurtenance, or for constructing, altering or repairing any boat, vessel or other water craft, by virtue of contract with the owner or agent thereof, shall have a lien to secure payment of the same upon such building, vessel, etc., together with the interest of the person owning such building to the land upon which it is situated, not exceeding 40 acres, and, if in a city, town or village plat, upon the lot upon which it is erected, not to exceed one acre.

Upon entering into a contract, to do labor or furnish materials, for which a lien might accrue, if the contractor shall enter into a bond with

the owner guaranteeing the payment of all persons who may do work, etc., under the contract, said bond to be filed according to law, no lien shall attach in favor of the persons mentioned above.

To obtain such lien the person entitled shall, within 60 days of the time of performing the service, file in the office of the register of deeds a full statement of the account between himself and the person from whom the account is due, and such certified statement shall act as a lien for one year from the time of rendering the service. When work is suspended without the consent of laborers and material men, etc., they may proceed with it at their own cost, in accordance with the original contract, as far as may be necessary to prevent the work already done from going to waste.

Where lands or building cannot be sold, they may be leased to satisfy lien-holders. In case of settlement of business, the liens of employes for wages, not to exceed $200, shall have preference.

IOWA.

From McLain's Annotated Statutes. Revision of 1880. Page 596.

Every mechanic or other person who shall perform any labor on, or furnish any materials, machinery, or fixtures for, any building, erection or other improvement upon land (including those engaged in the construction or repair of any work of internal improvement) by virtue of any contract with the owner, his agent, trustee, contractor, or sub-contractor shall have a lien upon such buildings, etc., and upon the land belonging to such owner upon which they may be situated, to secure payment for such labor done, or materials, etc., furnished. The entire land is subject to the above liens to the full extent of the owner's interest therein when such service was rendered for his benefit. When the owner of the building has only a lease-hold interest in the land, the forfeiture of such interest shall not impair the lien on the building, which may be sold to satisfy the same, and removed 30 days after the sale. When such service shall have been rendered in the construction, repair or equipment of any railroad, canal, viaduct, or other similar improvement, the lien shall extend to the erection, excavations, embankments, bridges, road-bed, and all lands upon which they may be situated, except the right of way, and these shall constitute the building, erection, or improvement mentioned in the statute.

Every person wishing to obtain such lien shall file with the clerk of the district court of the county in which the building, etc., may be situated a just and true statement of the amount due him after allowing all credits, stating the time when such service was rendered, and when completed, and containing a correct description of the property to be charged with the lien, and verified by affidavit.

Such statement must be filed by a principal contractor within 90 days, and by a sub-contractor within 30 days from the completion of the contract. Where the claim is upon a railroad, it may be filed within 60 days after the last day of the month, in which the service was rendered. A failure to file the claim within the periods mentioned, shall not defeat the lien, except where it may concern purchasers and encumbrancers in good faith without notice, whose rights accrued after the expiration of the required period and before the claim was filed.

To preserve his lien as against the owner, and to prevent payments by the latter to the principal contractor, or to intermediate sub-contractors, the sub-contractor must, within the period mentioned in the preceding clause, serve a written notice, of the filing of such claim, on the owner, etc. When filed and served after the expiration of the 30 days, the lien shall be enforced only to the extent of the balance due from the owner to the principal contractor, at the time of such service.

The mechanic's lien provided for in this statute shall take priority as follows: *First.*—As between themselves, in the order of filing the statement. *Second.* They shall take priority to all encumbrances made upon the owner for the contract debt. *Third.*—They shall have priority to all other subsequent liens and encumbrances, except as before given, when the statement is filed after the specified time. *Fourth.*—If there were previous encumbrances upon the land, such claims shall have preference as to the value of the land, while the lien provided for in this statute shall have preference as to the value of the improvement, if it be a new one. If the service rendered be for repairs, the prior encumbrance has preference as to the value of the property before the repairs were begun, and the lien has preference as to the value of the repairs as compared to the previous value of the property. Where the improvement is a separate building that can be removed, it may be sold by order of court. If the premises must be sold as a whole, the court will adjust the several claims as above.

Upon the written demand of the owner, etc., the person claiming the lien shall commence suit, to enforce such lien, in the district or circuit court, within 30 days thereafter.

Definitions and Decisions.—All persons furnishing materials and doing work as above, except those that have contracts directly with the owner, proprietor, agent or trustee, shall be considered sub-contractors. The contract need not be express, or in writing. A husband cannot act in regard to his wife's property without her consent. A lien attaches to the building, and not to the material furnished. A person furnishing material under contract has a lien for all the material furnished, whether used or not. A laborer employed by a sub-contractor, when the latter has been paid in full by the contractor, cannot enforce a lien against the owner.

MICHIGAN.

From Public Acts of 1879.

Every person who shall, in pursuance of a contract, express or implied —existing between himself, as contractor, and the owner, part owner, lessee, or person holding under any land contract or otherwise, any interest in real estate, – build, alter, improve, repair, erect, beautify or ornament, or who shall furnish any labor or materials for such purpose in or for any house, building, machinery, wharf or other structure, and every person who shall, as sub-contractor, laborer or material-man, perform or furnish to any such original or principal contractor, any labor or materials in carrying forward such contract, shall have a lien therefor upon such house, or other structure, and its appurtenances, and also upon the entire interest of such owner, etc.. in the lot or piece of land upon which it may stand, said piece of land not to exceed one quarter-section, or if in an incorporated village or city, not to exceed the lot or lots upon which it may stand. The liability of the holder of the house or lands shall not exceed his interest in the same at the time the contract was made, and the total amount of such liens shall not exceed the amount due, or to become due on such contract.

A lien holds if the service was performed upon the lands of a married woman by contract with her husband and *with her consent.*

Such lien shall not attach unless the contractor or otherwise, as the case may be, shall file in the office of the register of deeds of the county in which the lands, etc., are situated, a written notice, substantially in the following form:

To All Whom it May Concern: *Take Notice!* — That I intend to claim a lien upon the following premises, and the tenements and appurtenances thereon, for labor and materials furnished or to be furnished by me, as contractor (*or sub-contractor, or laborer, as the case may be*) under a certain contract existing between.....as owner (or otherwise), claiming an interest in said premises, and.....as contractor, for.....(*building, repairing, putting in machinery or otherwise*), which premises are described as follows: (Giving the proper real estate description.)

[Signed],

.....,

Contractor (*or as the case may be.*)

A copy of which notice shall be served on the owner. The owner shall not be bound beyond the amount due at the time of filing and serving such notice, or which may thereafter become due.

The party filing such claim, shall, whenever required by the owner, furnish a statement of work and materials furnished to date and still unpaid, and 30 days from completion of contract make affidavit of the amount

actually due him over and above all credits, and file it in the same manner as the original claim, together with proof by affidavit of the due service of notice on the owner.

The several liens upon the same party, under the same contract, shall be deemed simultaneous mortgages, and shall continue for 60 days and no longer after such affidavit is filed, unless proceedings are begun, as provided, to enforce them.

When the owner shall have failed to perform his part of the contract, and therefore the other party, without his fault, shall have been prevented from completely performing his part, he shall be entitled to pay for as much as he has done, in proportion to the price stipulated for the whole, and the court shall adjust his claim accordingly. When several lien-holders have equal rights as between themselves, payment shall be made *pro rata*.

OHIO.

From Revised Statutes of 1880. Chapter IV, Vol. 1, Page 825.

A person who performs labor, or furnishes machinery or material for constructing, altering or repairing a boat, vessel or other water craft; or for erecting, altering, repairing or removing a house, mill, manufactory or other building, appurtenance, fixture, bridge or other structure, under contract with owner, authorized agent, executor or administrator, shall have a lien to secure payment for same upon such vessel, bridge, etc., or upon such structure and upon the interest of owner in lot of land upon which it stands or to which it may be removed.

Such person to obtain such lien, shall, within four months from the time such service was rendered or such material furnished, file with the Recorder of the county in which such service was performed or material furnished an affidavit containing an itemized statement of account between himself and the owner; also a copy of the contract, if in writing, if not, a statement of verbal agreement; also description of lands on which such structure may stand or to which it may be removed. Shall operate as a lien from date of first item; and shall stand for two years from date of filing; or, if action is begun within that time, until the final adjudication thereof. There shall be no exemption against such lien.

A person who furnishes labor or materials upon any road, sidewalk, sewer, ditch, etc., by virtue of private contract with owner or agent of lands abutting, shall have a lien on such lands, to be obtained as above, but to stand for but one year. If several persons hold several liens, thus obtained, on the same job, they shall have no priority among themselves, but payment shall be made pro rata. If defective title prevents sale of lands to satisfy such lien, it shall be leased for benefit of lien-holders.

Sub-contractors, material men, laborers, etc., may have lien upon payments due head contractors from owner, board or public officer. Such lien shall be filed as above, and also with the owner, board or public officer. Such claims of laborers, mechanics and material-men shall be paid before those of sub-contractors, and those of sub-contractors before those of head contractors. If owner or agent refuse to pay such claim the holder shall have a lien upon the structure or upon the lands upon which it stands: such lien to have precedence over liens of head contractors.

Definitions, Etc.—The term "owner" includes also the owner of a lease-hold. Material must be furnished for the particular structure. When contract is for an entire job at an entire price, no itemized account is necessary.

KENTUCKY.

Revised Statutes of 1873. Page 620.

A person who performs labor or furnishes material in the erection, altering or repairing of a house, building, or other structure, or for any fixture or machinery therein, or for the improvement, in any manner, of real estate by contract with, or by the written consent of the owner, shall have a lien thereon, and upon the land upon which such improvement may have been made, or on any interest such owner has in the same, to secure the amount thereof with costs. If the owner claims by executory contract, and if, for any cause, such contract shall be set aside, the lien shall follow the property into the hands of the person to whom the same may come, to the extent only that the actual value of the property may be enhanced by the improvements so placed upon it.

If an evicted owner or claimant shall be entitled to compensation for improvement, the rights of the lien holder shall be substituted for those of the person so evicted. If improvements are made by contract with a lessee, and during the term of the lien, the lessee's interest shall return to the owner, and the owner shall refuse to accept such improvement, the lien-holder may remove the same, provided it can be done without injury to previous improvements.

If the work is done or materials furnished, not to the owner, but to a contractor or sub-contractor notice shall be given to the owner that a lien will be claimed. Then it shall be the duty of the owner to with-hold a sufficient amount to satisfy the claim. If he shall fail so to do, the property shall be in lien. *Provided*, that no lien shall exist in favor of such persons, in case the contractor himself is not entitled to a lien, nor if security shall have been taken for the labor performed or materials furnished.

The claimant within 60 days after the completion of the contract shall file with the clerk of the county court a full statement of account and

description of the property intended to be covered in the lien. Actions to inforce such liens shall be brought within six months from the last named dates, except in case of the death of the defendant, when a further six months shall be allowed.

INDIANA.

From Revised Statutes of 1876. Vol. 2, Page 266.

Persons performing labor or furnishing materials for the construction or repair of any building, may have a lien, separately or jointly, upon the building which they may have constructed or repaired, and on the interest of the owner in the lot or land on which it stands, to the extent of the value of the labor done, or materials furnished or for both.

The provisions of this act shall extend to work done on any new building; and to a contract entered into with the owner of any building for repairs, provided such are furnished with the consent of the owner of the land on which the building may be situated, but not to any contract made to the tenant, except only to the extent of his interest.

Persons wishing to obtain a mechanic's lien may give notice in writing to the owner of the amount of his claim, and what are the services for which his employer is indebted to him. The owner shall be liable for such claim, not to exceed the amount due or to become due from him to the employer, which claim may be recovered in an action whenever an amount equal to such claim over other claims having priority shall be due from such owner to the employer; and any sub-contractor by giving notice as above of the amount of labor or materials he has engaged to furnish, shall have the same claim against the owner for service rendered after the notice is given, as is given above to mechanics, etc. Whenever action is brought against an owner, all sub-contractors, journeymen and laborers who have given due notice, as required, may become parties to such action, and, upon judgment, the amount collected shall be divided *pro rata*.

The person wishing to obtain such lien shall, also, file in the recorder's office, within 60 days after completion, whether his claim be due or not, notice of his intention to hold a lien, setting forth the amount claimed, and time when labor, etc., began to be furnished, and shall have precedence over all subsequent claims except other mechanic's and materialmen's liens.

Any person having such lien may enforce it in the circuit court or court of common pleas of the county in which the service was rendered, within one year from the completion of the work or expiration of credit if given. The court rendering judgment shall order the sale to be made, such

sale to be without prejudice to the rights of any prior encumbrancer, owner or other persons not parties to the action.

All boats, vessels and water-craft of every description, found in waters of this state, including wharf-boats and floating warehouses, which are liable to be removed from place to place, are liable: 1.—For all debts contracted either within or without the state. 2.—For all damages arising from neglect of contract entered into in connection with the business of such boat, etc. 3.—For all injuries done to persons and property by such boat, etc., or by owners, officers or crew done in connection with the business of the same. Claims, if growing out of the above causes, are liens upon the boat, etc. Among such liens, mariners' and boatmen's wages shall be preferred. (Act of March 29, 1879.)

In case of settlement by process of law of the business of any company, corporation, person or persons, debts owing to laborers or employes shall have preference to the extent of $50 for labor performed within six months next preceding such seizure, or if not enough to satisfy, they shall be paid *pro rata*.

Decisions, Etc.—The construction of a pavement abutting on a lot is not embraced in the mechanics' lien law. To make the property of a married woman subject to the mechanic's lien law, she must have done what would have made her personally liable as an unmarried woman. A prior mortgage as also dower interest is equivalent to a mechanics' lien.

A mechanics' lien can be enforced for work done and materials furnished in the erecti n of a school house, built by order and contract of a trustee. A lien on a boat cannot be lost by delay, if there was no opportunity to enforce it.

WISCONSIN.

From Revision of 1878. Page 845.

Every person who, as principal contractor performs any labor, or furnishes any materials for the erection, construction, repairs, protection or removal of any building, or of any machinery erected or constructed, so as to become a part of the freehold upon which it is situated, or of any bridge, or in the filling up of any water lot, or in the construction thereon of any wharf or permanent erection, or in digging or constructing any well or fountain, or in building or repairing any fences upon land, or doing manual labor thereon, shall have a lien thereupon, and upon the interest of the owner of such building, etc., as above, in the land on which the same is situated, or of the person causing such manual labor to be done, not exceeding 40 acres, or if within the limits of any incorporated city or village, upon the piece of land used, or designed for use in connection with such building, etc., not exceeding one acre. Such lien shall

be prior to any other lien which originates after the work has been begun.

Every person who, as sub-contractor of a principal contractor, performs any work for, or furnishes any material to, a principal contractor, in any of the cases mentioned above, shall have a lien, if within 30 days after rendering such service, he shall give notice in writing to the owner of the property to be affected by it, setting forth that he has been employed by such principal contractor to furnish and has furnished such work, etc., with a statement of the items and the amount due therefor, and that he claims a lien; but the owner shall not be liable only so far as he is indebted to the principal contractor at the time of receiving the notice or thereafter; no sub-contractor of a sub-contractor has a lien. Liens under this statute are assignable, if notice is served on the owner within 15 days after assignment. The taking of a promissory note, or other evidence of indebtedness, shall not discharge the lien unless taken as payment, and so specified in the note, or otherwise.

Such lien shall not exist unless within six months from the date of the last charge for rendering such service, a claim for such lien shall be filed in the office of the clerk of the circuit court of the county in which it was rendered, nor shall an action be maintained unless brought within one year from such date. Such claim shall contain a statement of the contract, or demand upon which it is founded, the name of the person against whom it is claimed, the name of the claimant, the last dateof the rendering of service, a description of the property affected, a statement of the amount claimed and all other material facts. Any person having filed such claim may foreclose it in the circuit court, or other court having jurisdiction, and all such lien-holders on the same job may be joined as plaintiffs. They shall have no priority among themselves.

ILLINOIS.

From Revised Statutes of 1881, Page 696.

Any person who shall, as principal contractor, by contract, express or implied, with the owner of any lot or piece of land, furnish labor or materials, or services as an architect, or superintendent, in building, altering, repairing or ornamenting any house or other building, or appurtenance thereto on such lot, or upon street or alley and connected with such building or appurtenance, shall have a lien upon the whole of such tract of land or lot, and upon such house or building, or appurtenance, for the amount due him for such labor, material or services; *provided*, that the owner shall only be liable to the extent of his interest therein.

When the contract is expressed, there shall be no lien, if the time stipulated for the completion of the contract is beyond three years from its

commencement, or if the date of payment is more than one year from its completion. If the contract is implied, no lien shall be had unless the contract be completed within one year from its commencement.

The lien may be enforced, in any court of record of competent jurisdiction in the county in which the land, or part of it, may be situated, by bill or petition, which shall contain a brief statement of the express or implied contract, the amount due and unpaid, a description of the premises, and other material facts. When notice cannot be served upon the owner because he is out of the state, or cannot be found, the claimant shall file an affidavit of the fact with the clerk of the court, who shall act as provided by statute. All parties who have any legal or equitable right to the whole or part of the premises, may become parties to the suit any time before the final judgment. There shall be no preference among lien-holders under this act.

Previous encumbrances shall be preferred to the extent of the value of the property before the improvement was made, and the lien-holder shall have preference to the amount of his contract on the building, or other improvement erected, etc. Suit must be brought to enforce such lien; must be brought within six months after the last payment on contract shall have become due.

Every sub-contractor, mechanic, workman or other person, who shall, in pursuance of the original contract between the owner and the principal contractor, perform any labor, or furnish any materials for the purposes mentioned in the preceding part, shall have a lien as in the case of principal contractors, the aggregate of such liens not to exceed the price stipulated in the original contract, unless it shall appear to the court that the owner and principal contractor designed to defraud sub-contractors by fixing an unreasonably low price in the contract. Such person wishing to obtain such lien shall serve a notice, in writing, on the owner, substantially in the following form:

To..... You are hereby notified that I have been employed by..... to, (*here state whether to labor or furnish material, and substantially the nature of the contract*) upon your (*here state the building, and where situated, in general terms*); and that I shall hold the (*building, or as the case may be*), and your interest in the ground liable for the amount that (*is, or, may become*) due me on account thereof.

....., *Signature.*

This notice, with a copy of the contract, if it can be obtained, shall be served within 40 days after payment should have been made. The owner may retain money due the contractor to pay such claims, and if there is not enough to pay them in full, he shall pay them *pro rata*. If such

payment shall not be made within 10 days after the same may become due, suit may be brought to enforce it.

TENNESSEE.

From the Statutes. Compilation of 1871, Vol. 1, page 1,981.

There shall be a lien upon any piece of ground upon which improvements are made by contract with the owner or agent, in favor of the person or persons doing the work or furnishing the materials on or for the same. If the property be mortgaged, and the holder of the mortgage shall give his consent to the improvements, the lien shall have priority over the mortgage. If the mortgagee fail to object within 10 days after receiving notice, his consent shall be implied. A person shall have this lien, if at the time he begins to work, or to furnish material, he notifies the owner of his intention to rely upon a lien. The lien shall continue for one year from the completion of the contract, or until the decision of a suit that may be brought within that time.

WEST VIRGINIA.

Revised Statutes of 1879, Vol. 2, Page 751.

Every person doing work or furnishing materials on or for any building, by virtue of contract with the owner or his agent, or by agreement with the person holding such contract, shall have a lien upon the building and the land on which it is situated, not to exceed the contract price. Such liens shall have no priority among themselves, but shall be preferred to subsequent encumbrances.

To obtain such a lien, the claimant shall, within 30 days after he ceases to labor or furnish material, file with the clerk of the county court a sworn statement of the account and a description of the property. If a sub-contractor, within the same period, he shall serve notice on the owner of the amount of his demand, and that he intends to hold a lien against the owner's property. Suit to enforce such lien, must be brought within six months of the time of filing such claim, by filing a bill in chancery in the circuit court, in which all interested parties shall be made plaintiffs or defendants.

When the owner fails to perform his part of the contract, and the other party is therefore prevented from completing his part, the latter shall be entitled to compensation for as much as he has performed in proportion for the amount stipulated for the whole. Liens against corporations are for the same causes, and are enforced in the same manner as above.

CONNECTICUT.

From Revision of 1875. Page 359.

Any person furnishing material or rendering services to an amount exceeding $25 in the construction or repair of any building or appurtenance may have a lien on such building and on the land on which it stands, such liens to take precedence of subsequent encumbrances; *provided,* that no such lien shall attatch to any estate not owned by the party against whom such claim exists. A person wishing to obtain such lien shall file with the town clerk a certificate in writing, describing the premises, the amount of the claim and the date of the commencement.

No person other than the original contractor for the building or a sub-contractor, whose contract with such original contractor is in writing, and has been assented to, in writing, by the other party to such original contract, shall be entitled to claim any such lien, unless he shall, within 60 days from the time he commenced to render the service, give written notice to the owner of the building, that he has so commenced to furnish materials, or render services, and intends to claim a lien therefor on said building. The aggregate of such liens shall not hold to a greater extent than the price which the owner agreed to pay for such building and appurtenances. Sub-contractors are paid *pro rata,* and have priority over the principal contractor. No mechanic's lien shall continue in force for more than two years, unless suit shall have been brought within that time.

There is a lien on vessels by virtue of materials furnished or service rendered exceeding $20 in amount. Liens for mariners' wages have preference.

VERMONT.

From Revised Laws of 1880. Page 407.

Lien on Buildings:—When a contract is made, written or otherwise, for erecting, repairing, moving, or altering a building, or for furnishing labor or materials therefor, the person proceeding in pursuance of such contract or agreement shall have a lien to secure the payment of the same upon such building, and the lot upon which the same stands. And such lien shall continue in force for three months from the time when payment becomes due. But no lien shall attach until the person claiming it shall file in the town clerk's office of the town where such real estate is situated, a written memorandum, asserting such claim. Such lien shall also apply to a water-wheel or steam engine erected in or near a saw-mill, grist-mill or factory, to be used for the purpose of operating the machinery therein. Within three months from the time of filing such memor-

andum, if payment is due at that time, and, if not, three months after it becomes due, action may be begun thereon, and the said property may be attached.

These provisions shall apply to property held as a homestead. The real estate of a married woman may be charged with a lien when she assents to the contract.

Lien on Ships:—A person who performs labor or furnishes materials in building, repairing, fitting or furnishing a vessel, shall have a lien on the same for his wages or materials, until 8 months after it is completed, and may secure the same by an attachment which shall have precedence of all other claims. But before such lien shall attach, such person shall demand payment of the owner or agent, and if payment of the just amount is tendered, the lien shall be discharged.

MAINE.

From Revised Statutes of 1871.

A person who performs labor or furnishes materials in erecting or repairing any building, by virtue of an express or implied contract, has a lien on such building, and whatever interest the owner of the building has in the land on which it stands. The claimant must, within 30 days after completing the contract, file a full sworn statement of account, with a description of the property, with the town clerk. Suit to enforce the lien must be begun within 90 days after the same time.

There is an elaborate lien against vessels to secure payment for work done on them or material furnished, but it is too lengthy to give here.

NEW HAMPSHIRE.

From the General Laws, Edition of 1878. Page 334.

Any person who shall perform labor or furnish materials, to the amount of $15, or more, for erecting, altering, or repairing a house or other building or appurtenances, by virtue of a contract with the owner thereof, shall have a lien thereon and on any right of the owner to the land on which it stands; such lien to continue for 90 days after the completion of the contract, unless payment is previously made, and may be secured by an attachment thereon.

Persons rendering such services to a railroad shall have the same privileges. Any person rendering service by virtue of a contract with an agent, contractor or sub-contractor of the owner, may have the above lien by giving notice to the owner or person having charge of the property, that he intends to claim such lien.

MASSACHUSETTS.

From the General Statutes, Chapter 150.

Any person to whom a debt is due for labor performed or material furnished, and used in the erection, alteration or repair of any building or other structure upon real estate, by virtue of an agreement with, or by consent of the owner thereof, or any person having authority from the owner, has a lien on the property and lands tor his charges. Unless the labor or materials were performed or furnished by contract with the owner, he may prevent any lien from attaching, for work or materials not already performed or furnished, by giving written notice to the person performing the labor or furnishing the materials that he will not be responsible for the debt. Anyone having an interest in the property attached may release the same by giving sufficient bonds.

Liens are dissolved, unless the claimant, within 30 days after ceasing to work, files in the registry of deeds for the county or district where the property is situated, a true statement of the account, together with a description of the property and the owner's name; and suit to enforce the lien must be begun within 90 days after ceasing to work or furnish materials.

NEW YORK.

The general law relating to the whole state includes railway bridges and trestle work, wharves, piers, bulkheads and bridges.

The law appertaining to all but Erie, New York, Kings, Queens, Onondaga and Rensselaer counties provides for a lien for labor in erecting, altering or repairing any house, building or other appurtenances, or who shall furnish any materials therefor, which lien shall extend to the house, building and appurtenances, and to the extent of the right, title and interest of the owner of the land on which it is situate.

But if the improvement be by contract, the property shall not be held liable for more than the contract price.

If any payments are made collusively to evade the lien law, they shall not be considered in bar of the provisions of the law.

To constitute and perfect the lien, a notice thereof must be filed in the county clerk's office within 60 days after performance of the labor or final furnishing of materials.

Actions may be brought to enforce liens as follows: In the supreme court in any case. In the county court, when amount exceeds $50. In justice courts, when amount is less than $200. The limitation of liens is one year or until judgment, if proceedings have been instituted within one year. Appeals may be taken as in other cases.

Liens have priority as per date of filing notice with clerk. And there may be a judgment for any deficiency.

In New York city, the peculiarities are that laborers, cartmen, material-men and sub-contractors have precedence over contractors; and mortgages, exe uted before the performance of any work, shall not be affected or impaired by the lien. The notice of lien must be filed within three months from the time the work is done or materials furnished.

In Kings and Queens counties, the provisions are not materially different from the general law.

In Erie, Onondaga and Rensselaer counties, there is no provision of law for the registry or enforcement of liens.

When the notice of lien shall be given, a bill of particulars verified by the oath of the party shall likewise be served with it.

When the owner or party in interest is not in the state, so that notice cannot be personally served, a three weeks' consecutive notice by publication in a newspaper will suffice.

PENNSYLVANIA.

The lien of mechanics and material-m^n extends to buildings and to the ground covered thereby, and as much more ground as may be necessary for the ordinary and useful purposes of the building, but it does not extend to public buildings belonging to a county, nor to school-houses, n:r to railway depots, nor to public corporation bui dings used in their active operations; but churches are included.

The owner of the ground must enter in the "Mechanics' Lien Docket" in the prothonotaries office, the boundary of the lot he designs to improve and that becomes notice to all the world, and binds every one. A prior mortgage takes precedence of a lien. The lien shall exist for the benefit of plumbers, paperhangers, gasfitters, and furnishers of machinery for coal mines, also to wharves. The interest of a tenant for years is not such as will be bound by a mechanic's lien. If a woman owns real estate and her husband improves it with her consent, it will be bound by the lien.

Liens may also be taken for alterations and repairs, where the amount thereof is $50 or over.

There are special acts authorizing liens on leaseholds and fixtures pertaining to mines, which relate to several of the mining counties.

Every person entitled to a lien shall file a notice thereof in the prothonotaries office of the court of common pleas of the proper county, which shall set forth the name of owner, contractor, architect, builder and claimant; also, the amount due, kind of work done or materials furnished, time, etc., and full description of building, etc.

If more than one building is embraced in the same contract the lien may be apportioned. The lien shall continue for six months from the time of finishing the work or furnishing of materials. The proceedings in court to enforce the lien shall be by writ of *scire facias*.

When notice of the lien is filed with the prothonotary, it is good for five years. Where materials are furnished in pursuance of a contract, the limitation begins to run from the date of the last act done in pursuance of it. A contractor and a sub-contractor cannot file a joint claim.

A mechanic is bound to file his claim with certainty sufficient to give creditors and purchasers record-notice; and nothing less than certainty to a common intent will affect them.

A copper kettle or boiler in a brew-house is part of the freehold, and subject to the lien law; so are burr mill-stones; so is the engine by which a steam saw-mill is propelled.

A prior mortgage has precedence of a lien, although given for future advances.

THE LAW OF LOG LIENS.

MINNESOTA.

Whoever performs manual labor upon any logs or timber, shall have a lien upon such logs or timber to secure the payment of wages agreed to be paid for such labor, upon complying with the following requirements:

Before entering upon the performance of any such labor, the person proposing to perform the same shall cause to be filed and recorded in the office of the surveyor general of logs, for the district in which the mark of the logs or timber upon which the work is to be done is by law required to be recorded, a memorandum in writing of the contract, which memorandum shall contain: *First*—The names of the parties to the contract. *Second*—The proposed mark of the logs, etc. *Third*—Time when such labor is to be performed. *Fourth*—The amount, time and manner of payment agreed upon for such service, and shall be signed by both parties.

Action for enforcement of lien shall be brought within six months after filing.

MICHIGAN.

Any person or persons that may perform any labor or services in felling, cutting, hauling, banking, driving, running, rafting or booming any logs, timber or staves in this state, shall have a lien thereon for the amount due for such labor or services, and the same shall take precedence of all other claims thereon. In order to act as a lien a statement of the nature of the claim shall be filed with the clerk of the county in which the service was performed. In case the labor was running or driving logs it shall be filed in the county where the drive terminated. Such petition shall be filed within 15 days after the completion of such labor. *Provided*, that whenever such lien shall be claimed for labor done between October 30th and April 1st, next, such petition shall be filed on or before the 15th day of said April, and when done between March 30th and November 1st, it shall be filed on or before November 15; unless it be so filed such lien shall terminate. Suits shall be begun within three months from time of filing; *Provided*, that any sale or transfer of logs, etc., during the time for,

and previous to the filing of such statement shall not affect such lien, but it shall remain and be enforced against such logs, etc., in whosesoever possession found.

Any person having such lien may enforce the same by an attachment against the logs in the circuit courts of the state, making full statement of account, with affidavit. No sheriff or other officer shall attach or levy upon any such logs, etc., when in transit, when the destination is within the state. Such logs, etc., shall be released if the owner or agent shall give, according to law, a bond for double the amount claimed. No atachment shall be issued unless the amount due shall be $100 and upwards, but several claims may be combined, making the whole equal to $100 or upwards, when it shall be treated as one claim, and their agent or attorney shall be considered the plaintiff.

WISCONSIN.

Any person who shall furnish any supplies, rafting or other materials, or perform any service in cutting, felling, hauling, running, driving, rafting, booming, cutting or towing any logs or timber in the counties of Ashland, Barron, Bayfield, Brown, Burnett, Chippewa, Clark, Door, Douglas, Eau Claire, Fond du Lac, Jackson, Kewaunee, La Crosse, Lincoln, Manitowoc, Marathon, Monroe, Oconto, Outagamie, Pierce, Polk, Portage, Shawano, St. Croix, Taylor, Waupaca, Winnebago, or Wood, shall have a lien upon such logs or timber for the amount due for such supplies, etc., which shall take precedence of all other claims or liens thereon, and such liens for labor and services shall take precedence of such liens for supplies or materials; *Provided*, that in the counties of Chippewa and Taylor there shall also be such lien for the services of men and teams engaged in hauling supplies for those engaged in such business; but there shall be no lien for such supplies or materials furnished.

The word "supplies," as used in the preceding section, is applicable to all those counties except Lincoln, Marathon, Portage, Wood, Fond du Lac, Outagamie, Shawano, Waupaca and Winnebago, and such portions of Brown and Oconto, wherein such logs or timber are run down the Wolf river or any of its tributaries, and shall mean only feed for teams and the food used in camp to support the men; and in the other counties mentioned, the words "supplies, rafting or other materials" shall mean everything supplied for carrying on the business.

NEW HAMPSHIRE.

Any person who shall perform labor or furnish supplies to the amount of $15 or more toward rafting, driving, cutting, hauling, or drawing wood,

bark, lumber or logs, or at cooking or hauling supplies, in aid of such labor, shall have a lien thereon for such labor or supplies, which lien shall take precedence of all prior claims, except for public taxes, to continue 90 days (changed from 60 days, July 19, 1879) after the contract is completed, and may be secured by attachment.

Any sub-contractor can secure the same by giving notice, in writing, to the owner of his intention.

VERMONT

A person cutting or drawing logs shall have a lien thereon for his wages which shall take precedence of other claims except public taxes, and shall continue 60 days after the services are performed. But such lien shall not attach until the person claiming it files in the town clerk's office, or, if the town is not organized, in the county clerk's office, a brief statement of the contract and his purpose to enforce the lien.

Such lien shall have no validity against a subsequent purchaser unless a suit is brought and the logs attached within 30 days from the time the plaintiff's right of action accrues; and shall have no validity against anyone unless suit is brought and the logs attached within 60 days from such time.

MAINE.

A person who labors at cutting, hauling, rafting or driving logs or lumber, or at cooking for persons engaged in such labor, shall have a lien thereon for the amount due for his personal services, and the services performed by his team, which shall take precedence of all other claims, except liens reserved to the states of Maine and Massachusetts; to continue for 60 days after the logs or lumber arrive at the place of destination for sale or manufacture; and be enforced by attachment.

A lien on hemlock bark shall not continue after the bark reaches the market.

MISCELLANEOUS INFORMATION.

SEASONING AND SHRINKING OF TIMBER.

Were the properties of timber investigated with the same care and research bestowed upon metals it would be found that there is even a greater variation in them. A majority of the varieties of wood owe their commercial value to two particular characteristics; beauty of grain and susceptibility to polish.

The strength of a piece of timber depends upon the part of the tree from which it is taken. Up to a certain age, the heart of the tree is best; after that period, it begins to fail gradually. The ash, beech, elm and fir are generally considered at their best when of from 70 to 80 years growth, and the oak is seldom at its best in less than 100 years, much, however, depending on surrounding circumstances. As a rule, trees should not be cut before arriving at maturity, because there is then too much sap wood, which is the worst part, being softer and more liable to decay.

The strength of many woods is nearly doubled by the process of seasoning; hence timber used in its green state is not only weak, but is exposed to continual change of bulk, form and stability. Wood will always warp after a fresh surface has been exposed, and will change its form by the presence of moisture. The effect of moisture on dry wood is to cause the tubular fibres to swell; hence if a board be wet upon one side, the fibers there will be distended and it will bend. The natural law that governs the shrinking or contraction of timber is most important to practical men, but is too often overlooked. The amount of the shrinkage of timber in length when seasoning is so inconsiderable that it may in practice be disregarded (except in the redwood of the Pacific slope, which is said to shrink only in length), but the shrinkage in transverse directions is much greater, and presents some peculiarities which can only be explained by examining the structure of the wood as resulting from its mode of growth.

An examination of the end section of any exogenous tree, such as beech or oak, will show the general arrangement of its structure. It consists of a mass of longitudinal fibrous tubes, arranged in irregular circles, which are bound together by means of radial plates or rays, which have been variously named; they are the "silver grain" of the carpenter, or the

"medullary rays" of the botanist, and are in reality the same as the pith. The radial direction of these plates or rays and the longitudinal disposition of the woody fiber must be considered in order to understand the action of seasoning; for the lateral contraction or collapsing of the longitudinal fibrous or tubular part of the structure cannot take place without first tearing the medullary rays, hence the shrinking of the wooden bundles finds relief by splitting the timber in radial lines from the center, parallel with the medullary rays, thereby enabling the tree to maintain its full diameter. If the entire mass of tubular fiber composing the tree were to contract bodily, then the medullary rays would, of necessity, have to be crushed in the radial direction to enable it to take place, and the timber would thus be as much injured in proportion as would be the case in crushing the wood in a longitudinal direction.

If an oak or beech tree is cut into four quarters, by passing the saw twice through the center at right angles, before the splitting and contracting has commenced, the lines forming the angle of each quarter will be

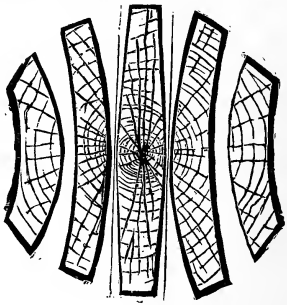


FIG. 1.

of the same length and at right angles to each other, or in techical language, square; but after storage in a dry place for a year, a great change will be found to have taken place, both in the form and in the dimensions of the pieces, The lines upon the two flat surfaces will still be of the same length as before, but the exterior diameter of the quarter circle will have contracted very considerably, and the two face lines will not be at right angles to each other, by reason of the collapsing of the vertical fibers, while the medullary rays will have been brought closer.

Supposing the log to be sawed into five pieces of plank, let us consider the action of the various pieces as shown in the diagram Fig. 1. After seasoning and contracting, it will be found that the middle of the center

plank still retains the original thickness, from the resistance of the medullary rays, while the thickness will be gradually reduced toward the edges, for want of support, and the entire breadth of the plank will be the same as it was at first. If, then, we take the planks at each side of the center, by the same law, their change and behavior will be quite different. They will still retain their original thickness in the center, but will be a little reduced on each edge throughout. But the side next to the heart of the tree will be pulled round or bent convex, while the outside will be the reverse, or hollow, and the plank will be considerably narrower throughout its entire length, more especially on the surface of the hollow side. Selecting the next two planks, they will be found to have lost none of their thickness at the center, and very little of their thickness at the edges, but very much of their breadth, and will be curved round on the heart side and made hollow on the outside. Suppose some of these planks to be cut into square prisms when in the green state; the shape that these prisms will assume after a period of seasoning will entirely depend upon the part of the tree to which they belonged, the greatest alteration being perpendicular to the medullary rays. Then, if the square was originally near the outside, as shown by the black border lines in Fig. 2,

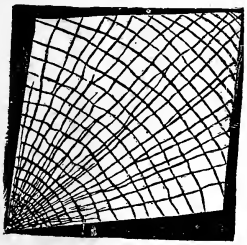


FIG. 2.

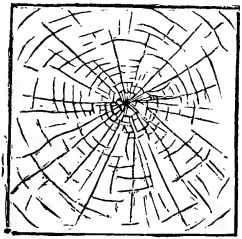


FIG. 3.

the effect will be a contraction, as shown by the inside lines. After a year or two the square end of the prism will become rhomboidal. By understanding this natural law, it is comparatively easy to predict the future behavior of a board or plank, by carefully examining the end wood, in order to ascertain the part of the log from which it has been cut, as shown by the angle of the ring growths and the medullary rays.

If the stick of sawed timber be cut so as to leave the heart in or near the center, it will season square in form, but the end will show a fracture of the medullary rays, commonly spoken of as season-checking, as illustrated in Fig. 3. Here the contrast between the rhomboidal seasoning of

the stick sawed from the outside diameter of a log, and that in which the heart is left, is made quite plain. All sawyers who have been puzzled with the warping of logs upon the mill carriage will in this severance of the medullary rays find an explanation of the phenomenon, which is less marked in soft timber than in the closer grain of southern and Norway pine, or of oak, beech and other hardwoods.

QUARTER AND BASTARD SAWING.

Quarter-sawing and rift-sawing are the same. To secure the minimum of shrinkage or warp, a board must be rift-sawed, which means cutting the medullary rays at right angles with the circles of growth. Quartered oak is simply rift-sawed, the designation "quartered" arising from the common method of first cutting the log into quarters, and then cutting the quarters as shown in Fig. 1 of the following diagrams. The lines

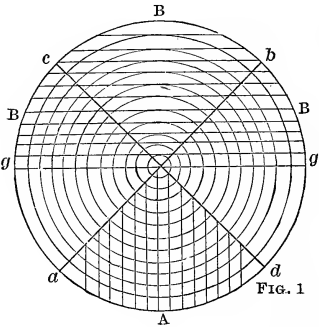


FIG. 1

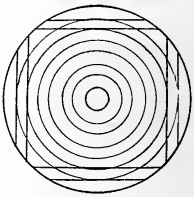


FIG. 2

a o, *c d* are those upon which the log is supposed to be quartered. The circles represent the concentric rings of the tree's growth. The straight lines across the upper half of the log, B, show the ordinary method of slicing it up into boards with a circular or gang. Wherever the cut of the saw crosses the circles at right angles or nearly so that much of the board is rift-sawed; when it runs nearly parallel with them it exposes the grain, and is what is rather inelegantly termed bastard. The board nearest the middle, *g g*, will be almost a perfectly rift-cut piece, while the fourth one from it toward the outside will be just about half rift and half bastard. Supposing the lower quarter A to be cut out from the log, the common and most simple method of quarter-sawing it is to make the cuts, as shown by the straight lines which cross the concentric

rings at sufficiently near right angles for making good flooring. Each piece, however, will have a bevel edge as shown, which must, of course, be squared by the edger. Special arrangements of mill carriage and head blocks are in use for rift-sawing when great accuracy is desired.

The method of bastard-sawing is illustrated in Fig. 2. It simply consists of so turning the log upon the carriage as to expose the grain as much as possible. The diagram only shows cuts that would make an ordinary cant of the piece, but the judgment of the sawyer must be exercised to so turn the log as will make its form square, octagon or hectagon, as may be best to expose instead of cut across the grain, and allow its curve to show in the center of the board. Both of these methods of sawing, as will be seen, are wasteful to the timber, a matter that cannot well be avoided. Judicious bastard-sawing in certain kinds of wood, such

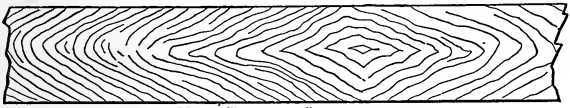


FIG. 3 BASTARD SAWED

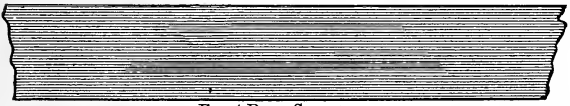


FIG. 4 RIFT SAWED

as oak or ash, develops some very beautiful grain effects, and for ornamental finishing purposes enhances the value of the wood to as great, or even a greater degree than by rift-sawing it, as the latter is mainly required where the stuff is to withstand continuous wear, as in the case of flooring, or is to fill a place where it must neither shrink nor warp, as in the case of sounding or reed boards in musical instruments. The appearance of pieces of lumber cut rift and bastard may be seen in Figures 3 and 4. If laid in a floor Fig. 3 will wear rapidly and unevenly, and always have a tendency to sliver, while Fig. 4 having the ends of the grain exposed to receive the wear, will greatly outlast it, wear more evenly and present a much better appearance. On the other hand as the panel to a desk or other piece of furniture, Fig. 3 would be much more handsome than the other.

CAPACITY OF CISTERNS.

To find the capacity of a cylindrical cistern or other vessel in gallons and barrels (such a vessel has a circle for its bottom and has perpendicular sides)—Multiply the square of the diameter by the depth (all in feet),

and multiply the product by 5.875+ for gallons or by .1865 for barrels. These results are correct within within a very small fraction.

Table of capacity for each 6 inches in depth of cisterns from 6 inches to 25 feet in diameter in standard gallons of 231 cubic inches and barrels:

DIAMETER.	GALLONS.	BARRELS.	DIAMETER.	GALLONS.	BARRELS.
6 in.....	.7344..	.023..	12 ft. 6 in..	457.7489..	14.589..
8 in.....	1.3056..	.041..	13 ft.....	496.4532..	15.766..
9 in.....	1.6524..	.052..	13 ft. 6 in..	535 8763..	17.002..
10 i	2.0800..	.065..	14 ft.....	575.7682..	18.285..
12 in.....	2.9376..	.093..	14 ft. 6 in..	617.6289..	19.615..
1 ft. 6 in...	6.6096..	.210..	15 ft.....	660.9584..	20.990..
2 ft.....	11.7500..	.373..	15 ft. 6 in..	705.7567..	22.413..
2 ft. 6 in...	18.3599..	.583..	16 ft.....	752.0238..	23.882..
3 ft.....	26.4383..	.839..	16 ft. 6 in..	799.7597..	25.398..
3 ft. 6 in...	35.9855..	1.143..	17 ft.....	848.9644..	26.960..
4 ft.....	47.0015..	1.492..	17 ft. 6 in..	899.6378..	28.570..
4 ft. 6 in...	59.4862..	1.889..	18 ft.....	951.7801..	30.226..
5 ft.....	73.4398..	2.332..	18 ft. 6 in..	1005.3912..	31.929..
5 ft. 6 in...	88.8622..	2.822..	19 ft.....	1060.4711..	33.677..
6 ft.....	105.7533..	3 358..	19 ft. 6 in..	1117.0197..	35.473..
6 ft. 6 in...	124.1133..	3.941..	20 ft.....	1175.0372..	37.316..
7 ft.....	143.9420..	4.571..	20 ft. 6 in..	1234.5235..	39.205..
7 ft. 6 in...	165 2396..	5.247..	21 ft.....	1295.8785..	41.141..
8 ft.....	188.0060..	5.971..	21 ft. 6 in..	1357.9024..	43.123..
8 ft. 6 in...	212.2411..	6.740..	22 ft.....	1421.7950..	45.152..
9 ft.....	237.9450..	7.556..	22 ft. 6 in..	1487.2827..	47.228..
9 ft. 6 in...	265.1178..	8.419..	23 ft.....	1553.9867..	49.350..
10 ft.....	293.7593..	9.329..	23 ft. 6 in..	1622.2857..	51.519..
10 ft. 6 in...	323.9696..	10.285..	24 ft.....	1692.0536..	53.735..
11 ft.....	355.4487..	11.288..	24 ft. 6 in..	1763.2902..	56.184..
11 ft. 6 in...	388.4966..	12.338..	25 ft.....	1830.9956..	58.356..
12 ft.....	423.0134..	13.434..			

To find, by means of the above table, the capacity of a cylindrical cistern—Multiply the number in the table opposite the given diameter by the number of times 6 inches is contained in the given depth.

EXAMPLE:—Find the number of gallons contained in a tank 18 feet in diameter and 15½ feet deep. By the table the capacity of a vessel 18 feet in diameter and 6 inches deep is 951.7801 gallons, 6 inches is contained in 15½ feet 31 times, 951.7801×31=29505.1831 the number of gallons. The above table will give results correct to thousandths of gallons and hundredths of barrels.

To find the contents of a corn crib: RULE—Multiply the number of cubic feet by 4½ and point off one decimal place—the result will be the answer in bushels. How many bushels will a crib hold that is 48 feet long, 7½ feet wide and 8½ feet high?—$48\times7\frac{1}{2}\times8\frac{1}{2}=3{,}060$ cubic feet; $3{,}060\times4\frac{1}{2}=12{,}240$; $12240+1530=1377$. bushels, answer.

LOG SCALING.

The first thing a log scaler determines is the length of the log, then its quality or grade, which must be determined by the defects visible to the eye. These consist of crooks, knots, punks, hollows, etc. Looking at both ends of the log he ascertains whether there is any hollow, or ring rot, and if the butt is free from shake. Having settled these points, he lays his rule on the narrowest diameter of the small end of the log. If it is crooked, he takes his diameter (always inside the bark) from a point which allows the saw to pass through the log fully removing the slab. If the butt is hollow, he adds three inches to the diameter of the hollow, multiplies the size by itself, and deducts from the gross measurement. If it is a shaky log he allows for that in determining the quality. If it has not been properly square butted, he makes a memorandum so that the expense of butting can be charged to the seller, or logger, unless in in the bargain he is instructed to deduct enough from the measurement to cover the cost. A log cannot be considered merchantable until it is fully prepared for market. If it is very knotty, he lowers its grade accordingly, if he is grading in quality. If the knots are large, black or rotten, he is to determine the class in which the log belongs by the damage caused by the defects. If the defect is ring rot, he should take no account of the log at all, as it is not worth the expense of handling, in a majority of cases. If a log is less than 24 feet long, it should be measured at the end; over that length it is usually measured in the middle by calipers. In very long timber it is sometimes customary to measure at lengths of 12, 14 or 16 feet; this, however, is a matter of agreement between buyer and seller. Dead timber is always measured inside the decayed or black stained sap. In many hardwood sections the sap is always excluded from the diameter of the log. Bright sap in pine, hemlock, poplar, whitewood, basswood and spruce is always measured. Diameters are always to be taken inside of the bark the smallest way of the smallest end of the log.

For sharpening saws and grinding all kinds of cutters for wood-working, Tanite emery wheels are generally considered the best thing to use. Grinding machines for all sorts of purposes are in use, and reduce the trouble and labor of gumming and sharpening to the minimum. In any well regulated mill or factory, a small outlay judiciously made in this direction never fails to yield large returns.

LAND MEASURE.

To find the number of acres in a rectangular piece of land (a rectangle has all square corners)—Multiply the length by the breadth (in rods) and divide by 160; or, if the dimensions are measured in feet, divide by 43,-

560. To find the number of acres in a triangular piece of land—Multiply the length of one side by half the perpendicular distance between that side and the opposite corner (lengths in rods), and divide the product by 160. EXAMPLE: We have a piece of land, *A B C*, (Fig. 1) the side *A C*, is 80 rods long, and the distance *D B*, is 30 rods; ½ of 30=15, 80×15=1200, 1200÷160=7½, the number of acres in piece.

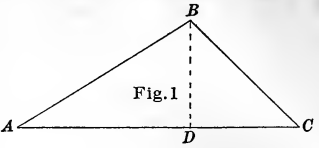


Fig. 1

To find the number of acres in a quadrilateral, having two opposite sides parallel, (such is Fig. 2)—Multiply half the sum of the parallel sides by the perpendicular distance between them, in rods, and divide the product by 160. EXAMPLE: Given a piece of land *A B C E*, (Fig. 2) with the side *B C* parallel to *A E*. *A E* =120 rods, *B C*=95 rods, *C D*=70 rods (120+95)÷2=107.5 107.5×70=12,525, the number of square rods in piece, 12,525÷160=78 9-32, the number of acres.

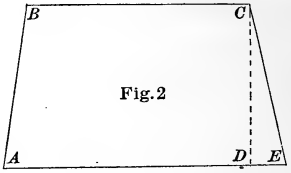


Fig. 2

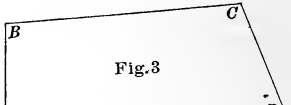


Fig. 3

To find the area of a field having the opposite sides nearly parallel—Multiply half the sum of two opposite sides by half the sum of the other two sides. EXAMPLE: In Fig. 3 the opposite sides *A D* and *B C* are nearly parallel as also the sides *A B* and *C D*. *A D*=120, *B C*=100, *A B*=40, *C D*=55. Then the area of the figure is expressed as follows: area=(120+100)÷2×(40+55÷2=5225. If the measure was taken in rods, 5225÷160=32⅝ nearly, the number of acres in a piece of land of those dimensions This last rule is not geometrically correct, but in such a case as that given the result is near enough for most purposes. If perfect accuracy is desired, or the piece

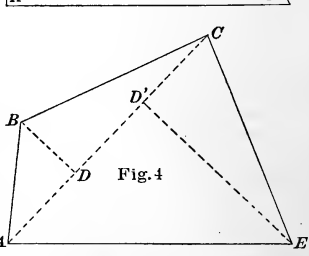


Fig. 4

is of more irregular shape, the method indicated in Fig. 4 should be adopted, *i. e.:* divide the whole piece into triangles and obtain the area of each as directed. This will apply to fields of any number of sides.

NAILS.

Nails are put up 100 pounds to the keg.

SIZES.	LENGTH INCHES.	NAILS IN A POUND.	SIZES.	LENGTH INCHES.	NAILS IN A POUND.
3d fine blued	1⅛	725	6d fence.....	2	80
3d common blued	1¼	400	8d "	2½	50
4d " "	1½	300	10d "	3	30
6d " "	2	150	12d "	3¼	27
8d " "	2½	85	16d "	3½	20
10d " "	3	60	6d finishing....	2	317
12d " "	3¼	50	8d "	2½	208
16d " "	3½	40	10d "	3	126
20d " "	4	20	6d clinching...	2	118
30d " "	4½	16	8d "	2½	80
40d " "	5	14	10d "	3	45
50d " "	5½	11	.....	.....	.....
60d " "	6	8	.....	.....	.....

Five pounds of 4d, or 3¾ pounds of 3d will lay 1,000 shingles. Five and three-quarters pounds of 3d fine will put on 1,000 lath.

Quantity of Seeds Required per Acre.

Wheat.....	1½ to 2	bu.	Beets.....	3	lbs.
Rye.....	1½	"	Carrots.....	2	"
Oats.....	3	"	Ruta bagas.....	¾	"
Barley.....	2	"	Millet.....	½	bu.
Peas.....	2 to 3	"	Clover, white.....	4	qts.
White beans.....	1½	"	Clover, red.....	8	"
Buckwheat.....	½	"	Timothy.....	6	"
Corn, broadcast.....	4	"	Orchard grass.....	2	bu.
Corn in drills.....	2 to 3	"	Red top.....	1 to 2	pks.
Corn in hills.....	4 to 8	qts.	Blue grass.....	2	bu.
Broom corn.....	½	bu.	Mixed lawn grass.....	1 to 2	"
Potatoes.....10	to 15	"	Tobacco.....	2	oz.

Hills in an Acre of Ground.

40 feet apart.....	27	hills.	8 feet apart..... 680 hills.
35 "	35	"	6 " ..... 1,210 "
30 "	48	"	5 " ..... 1,732 "
25 "	69	"	3½ " ..... 3,556 "
20 " 108		"	3 " ..... 4,840 "
15 " 193		"	2½ " ..... 6,969 "
12 " 302		"	2 " ..... 10,890 "
10 " 435		"	1 " .....43,560 "

MEASURES OF SURFACE.

Table of Ordinary Units.

144 sq. in.=1 sq. ft.
30¼ sq. yds.=1 sq. rod.
640 acres=1 sq. mile or section.
9 sq. ft.=1 sq. yd.
160 sq. rods=1 acre.
36 sections=1 township.

Comparative Table.

SQ. MI.		ACRES.		SQ. RODS.		SQ. YDS.		SQ. FT.		SQ. IN.
1	=	640	=	102,400	=	3,097,600	=	27,878,400	=	4.014,489.600
		1	=	160	=	4,840	=	43,560	=	6,272,640
				1	=	30¼	=	272¼	=	39.204
						1	=	9	=	1,296
								1	=	144

Surveyors use the following table in measuring land:

625 sq. links make 1 pole.
16 poles make 1 sq. chain.
10 sq. chains make 1 acre.
640 acres make 1 sq. chain.
36 sq. miles (6 miles sq.) township.

Comparative Table.

TP.		SQ. MILES.		ACRES.		SQ. CHAINS.		POLES.		SQ. LINKS.
1	=	36	=	23,040	=	230,400	=	3,686,400	=	2,340,000,000
		1	=	640	=	6,400	=	102,400	=	6.400,000
				1	=	10	=	160	=	100.000
						1	=	16	=	10.000
								1	=	625

The square foot is used in estimating glazing, stone-cutting, etc.; the square yard in plastering, roofing, paving, etc.; the acre in measuring land.

Solid or Cubic Measure.

1728 cu. inches make one cu. foot.
27 cubic feet make one cubic yard.
46,656 cu. inches make one cu. yard.
40 cu. ft. of round timber=1 ton.
42 cu. ft. of shipping timber=1 ton.
50 cu. ft. of hewed timber=1 ton.
128 cu. ft.=1 cord.

Timber in one load—English.

50 cu. ft of square timber.
109 lin. ft. of 6x12 in. "
200 " of 6x6 "
150 " 4 in. planking 12 in. wide.
200 lin. ft. 3 in. planking 12 in. wide.
300 " 2 in. " "
400 " 1½ in. " "
600 " 1 in. " "

Liquid Measure.

The United States standard for measurement of all liquids is the "wine" or "Winchester" gallon containing 231 cubic inches.

4 gills make one pint.
2 pints " quart.
4 quarts " gallon.
31½ gallons make one barrel.
2 barrels " hogshead.

Dry Measure.

The Government standard of dry measure of the United States is the "Winchester Bushel" so called, being a cylindrical vessel having an inside

diameter of 18½ inches, and a depth of 8 inches, and containing 2150.42 cubic inches.

4 gills make one pint.	8 quarts make one peck.
2 pints " quart.	4 pecks " bushel.

Measures of Weight.

The Pound is the United States standard of weight as applied to general purposes, and is the weight of 27.7015 cubic inches of distilled water, at its greatest density (*i. e.* at 39° 83" Farenheit, the barometer being at 30 inches), and is equivalent to 7,000 Troy grains.

27 11-32 grains make one dram.	25 pounds make one quarter.
16 drams " ounce.	4 quarters make one cwt.
16 ounces " pound.	20 cwt. " ton.

(In some cases the following table for gross weight is used: 28 lb.=1 quar.; 4 quar.=1 cwt.; 20 cwt., or 2240 lbs.=1 ton.

Comparative Table of Weights.

	Troy.		Apothecaries.		Avoirdupois.
1 pound	equals 5,760	grains.	equals 5,760	grains,	equals 7,000 grains.
1 ounce	" 480	"	" 480	"	" 437.5 "
	175 pounds	"	175 pounds	"	144 pounds.

The half peck, or dry gallon, contains 268 8 cubic inches. Six quarts, dry measure, are equal to nearly 7 quarts, liquid measure.

Measures of Capacity.

The following table will often be found convenient, taking inside dimensions:

A box 24 in. x 24 in. x 14.7 will contain a barrel of 31½ gallons.
A box 15 in. x 14 in. x 11 in. will contain 10 gallons.
A box 8¼ in. x 7 in. x 4 in. will contain a gallon.
A box 4 in. x 4 in. x 3.6 in. will contain a quart.
A box 24 in. x 28 in. x 16 in. will contain 5 bushels.
A box 16 in. x 12 in. x 11.2 in. will contain a bushel.
A box 12 in. x 11.2 in. x 8 in. will contain a half bushel.
A box 7 in. x 6.4 in. x 12 in. will contain a peck.
A box 8.4 in. x 8 in. x 4 in. will contain a half peck, or 4 dry quarts.
A box 6 in. x 5 3-5 in., and 4 in. deep, will contain a half gallon.
A box 4 in. x 4 in., and 2 1-10 deep, will contain a pint.

Hay Measure.—About 500 cubic feet of well-settled hay, or about 700 of new mown hay, will make a ton. To estimate amount of hay in mow —Ten cubic yards of meadow hay weigh a ton. When the hay is taken out of old stacks, 8 or 9 yards will make a ton. Eleven or 12 cubic yards of clover, when dry, weigh a ton. (*Note*—The only accurate method to measure hay is to weigh it, since two quantities equal in bulk will never weigh alike. Any rule is simply an approximation.)

Floor, Wall and Roof Measure.—To find the number of square yards in a floor or wall: Rule—Multiply the length by the width or height (in feet), and divide the product by 9; the result will be square yards.

Number of Trees Required per Acre.

4 feet	apart each way		2,720	15 feet	apart each way		200
5	"	"	1,742	18	"	"	135
6	"	"	1,200	20	"	"	110
8	"	"	680	25	"	"	70
10	"	"	430	30	"	"	50
12	"	"	325	33	"	"	40

Dimensions of One Acre.

A square, whose sides are 12,649 rods, or 69.57 yards or 208.71 feet long, contains one acre. Table of dimensions of rectangle containing one acre:

RODS.

1 ×160	1½ ×106⅔	2 × 80	2½ × 64
3 × 53¼	3½ × 45 5-7	4 × 40	4½ × 35 5-9
5 × 32	5½ × 29 1-11	6 × 26⅔	6½ × 24 8-13
7 × 22 6-7	7½ × 21⅓	8 × 20	8½ × 18 14-17
9 × 17 7-9	9½ × 16 16-19	10 × 16	10½ × 15 5-21
11 × 14 6-11	11½ × 13 21-33	12 × 13⅓	12½ × 12 4-5
.....	.....	.....	12 13-20 × 12 13-20

Estimates of Materials.

3½ barrels of lime will do 100 square yards plastering, two coats.
2 " " " 100 " " one coat.
1½ bushels of hair " 100 " "
1¼ yards good sand " 100 " "
⅛ barrel of plaster (stucco), will hard-finish 100 square yards plastering.
1 barrel of lime will lay 1,000 brick. (It takes good lime to do it.)
2 " " 1 cord rubble stone.
½ " " 1 perch " (Estimating ¼ c'd to perch.)

To every barrel of lime estimate about ⅝ yards of good sand for plastering and brick work.

Rules Relating to Hydraulic Prime Movers.

Rule I. To calculate the *gross power* of a fall of water: To the actual head, add the height due to the velocity of water in the head-race. Multiply the sum by the volume of the flow of the water per second, and by the weight of water (62.4 lbs. per cu. ft.) The product will be the gross power in foot-lbs. per second. This divided by 550 equals the gross horse-power.

Rule II. To find the *net power* of a fall of water. Multiply the gross power by the probable efficiency of the prime mover to be used. That efficiency ranges in

Water pressure engines from	.65 to .75
Overshot and breast wheels	.70 to .80
Undershot wheels	.40 to .60
Turbine wheels	.60 to .80

To find the height of fall corresponding to a given velocity: Divide the half-square of the velocity by 32.2 (*g*).

Amount of Paint Required for a Given Surface.

It is impossible to give a rule that will apply in all cases, as the amount varies with the kind and thickness of the paint, the kind of wood or other material to which it is applied, the age of the surface, etc. The following

is an approximate rule: Divide the number of square feet of surface by 200. The result will be the number of gallons of liquid paint required to give two coats; or, divide by 18 and the result will be the number of pounds of pure ground white lead required to give three coats.

CIRCLES.

Table showing the circumferences and areas of circles with diameters from 1 to 50 with sides of equal squares:

DIAMETER.	CIRCUMFERENCE.	AREA.	SIDE OF EQUAL SQUARE.	DIAMETER.	CIRCUMFERENCE.	AREA.	SIDE OF EQUAL SQUARE.
1.	3.141	.7854	.886	22.	69.11	380.13	19.496
1.5	4.712	1.797	1.329	23.	72.25	415.47	20.383
2.	6.283	3.141	1.772	24.	75.39	452.39	21.269
2.5	7.854	4.908	2.215	25.	78.54	490.87	22.155
3.	9.424	7.068	2.658	26.	81.68	530.93	23.041
3.5	10.99	9.621	3.101	27.	84.82	572.55	23.928
4.	12.56	12.566	3.544	28.	87.96	615.75	24.814
4 5	14.13	15.904	3.988	29.	91.10	660.52	25.700
5.	15.70	19 635	4.431	30.	94.24	706.86	26.586
5.5	17.27	23.758	4 874	31.	97.38	754.76	27.473
6.	18 84	28.274	5 317	32.	100.5	804.24	28.359
6.5	20.42	33.183	5.760	33.	103.6	855.30	29.245
7.	21.99	38.484	6.203	34.	106.8	907.92	30.131
7.5	23.56	44.178	6.646	35.	109.9	962.11	31.017
8.	25.13	50.265	7 089	36.	113.0	1017.8	31.904
8.5	26.70	56.745	7.532	37.	116.2	1075.2	32.790
9.	28.27	63.617	7.976	38.	119.3	1134.1	33.676
9.5	29.84	70.882	8.419	39.	122.5	1194.5	34.562
10	31.41	78.539	8.862	40.	125.6	1256.6	35.449
11.	34.55	95.033	9.748	41.	128.8	1320.2	36.335
12.	37.69	113.09	10.634	42.	131.9	1385.4	39.221
13.	40.84	132.73	11.520	43.	135.0	1452.2	38.107
14.	43 98	153.93	12.407	44.	138.2	1520.5	38.993
15.	47.12	176.71	13.293	45.	141.3	1590.4	39.880
16.	50.26	201.06	14.179	46.	144.5	1661.9	40.766
17.	53.40	226.98	15.065	47.	147.6	1734.9	41.652
18.	56.54	254.46	15.952	48.	150.7	1809.5	42.538
19.	59.69	283.52	16.838	49.	153.9	1885.7	43.425
20.	62.83	314.16	17.724	50.	157.0	1963.5	44.311
21.	65.97	346.36	18.610	.....	.....	.....	.....

The circumference of a circle is the diameter multiplied by 3.1415926+, and the area is equal to the circumference multiplied by one-quarter the diameter; or, is equal to the diameter multiplied by .7854. These decimals being too extended for common use, the above table is an approximate one, correct as far as the decimals are carried.

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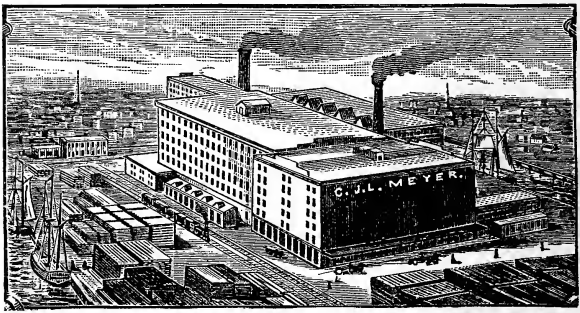

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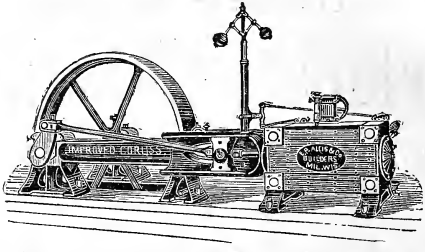

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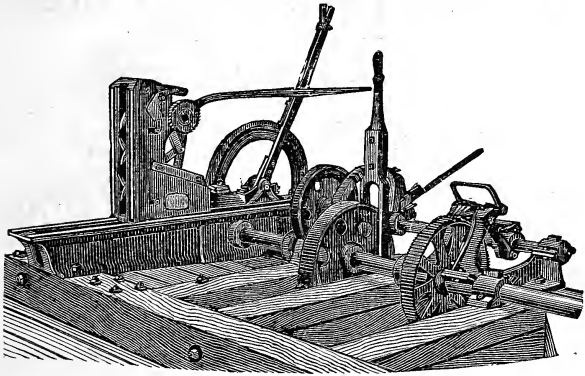

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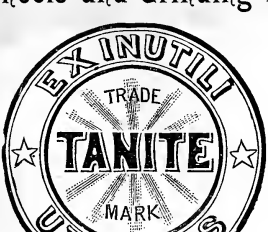

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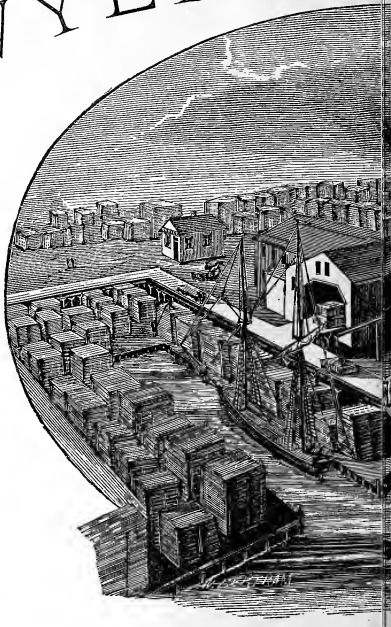

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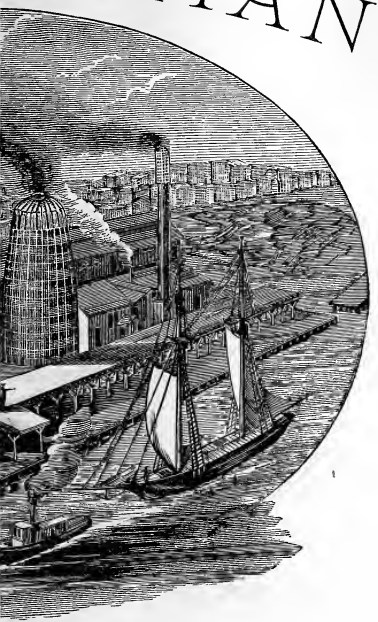

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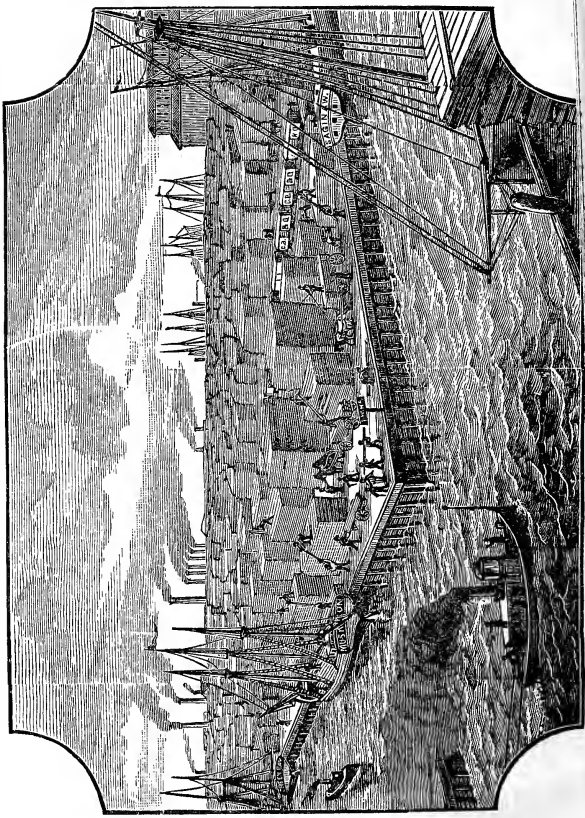

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MAP OF THE Chicago Lumber District

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—FOR THE—

LUMBERMAN'S HAND BOOK,

Showing the Location of all Pine and Hardwood Lumber Yards in the City with the Street Car Lines to be taken in reaching them; the Passenger and Freight Depots, Hotels, Theaters and Public Buildings.

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Anderson, The B. L. Co., Lathi..... 34
Andrews, Hamilton & Co., Hickory..... 44
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Gill, R. G. & Co., Maxwell, near Polk.. G
Hatch, Holbrook & Co., W. 12th.. O
Holden & Pendleton, Lumber, near
Maxwell..... F
Holbrook & Co., Grove and 17th..... B
Johns, T. B., Lumber and Maxwell... E
Larkin, Robert, W. 22d, near Union... A
Lorden, M. & T., Beech and Maxwell. C
McFarland, W. & Son, Morgan and W.
Kinzie..... M
Messenger, Hubbard & Granger, Sanganon and Halsted..... N
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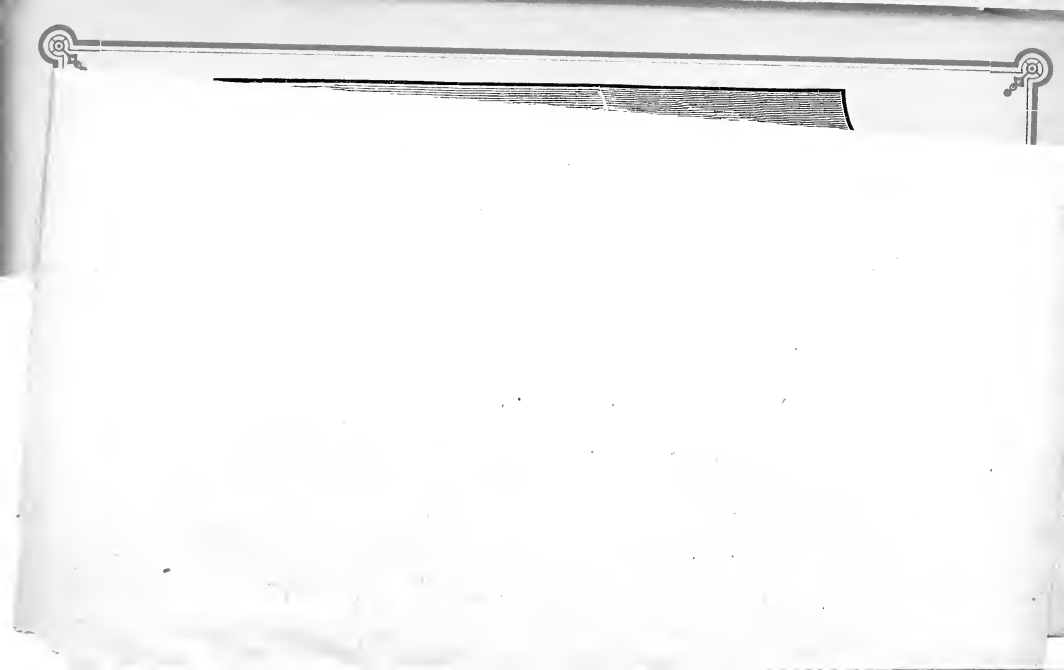

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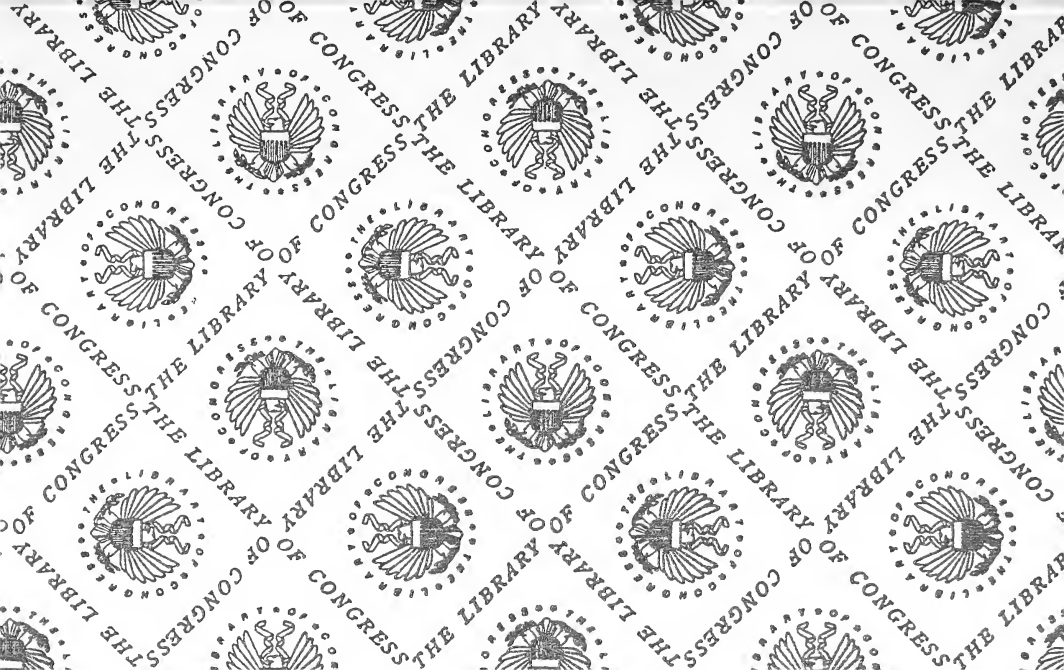
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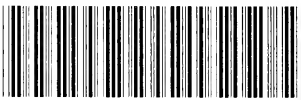
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